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User's Guide to the Rough Terrain Diffusion Model (RTDM) (Rev. 3.20)

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The User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 6 (Revised 1/88) contains 30 air quality simulation models. These models input emission and meteorological data to calculate projected air pollutant concentrations. UNAMAP contains state-of-the-art dispersion research algorithms funded by the EPA's Office of Air Quality Planning and Standards for Environmental Impact Analysis.

This manual describes a sequential version of the Rough Terrain Diffusion Model (RTDM, version 3.20). The model provides a method to estimate air pollutant concentrations from multiple co-located sources in a rural environment. RTDM can be used in flat or complex terrain, but it is especially suited for use in complex terrain.

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PREFACE

This manual describes a sequential version of the Rough Terrain Diffusion Model (RTDM, version 3.20), developed by Environmental Research & Technology, Inc. (ERT). RTDM has its origins in the modeling technologies ERT had developed and applied over a period of several years as part of its consulting services to both public and private sectors. In response to the March 1980 Federal Register "Call for Models," ERT submitted RTDM.WC, a case-study version of the model, for consideration by EPA. ERT felt that this model would fill an interim need for realistic assessments of pollutant dispersion in complex terrain settings.

RTDM version 3.20 retains the basic algorithms and features of RTDM.WC, including the unique way in which the model simulates plume behavior near terrain features by limiting reflection from the ground in accordance with the second law of thermodynamics. However, provisions have been made in this sequential version of RTDM to incorporate on-site hourly measurements of turbulence intensity, vertical temperature gradient, horizontal wind shear, and the vertical wind speed profile. In addition, a critical height (H_{crit}) is defined such that in stable conditions, plumes at heights less than H_{crit} will impinge upon terrain. Hourly values of stack emission parameters can also be accommodated by the sequential version of RTDM.

RTDM possesses several features not present in other air quality models routinely used for regulatory applications. Proper application of RTDM requires that the user be thoroughly familiar with the basic modeling concepts applied in the model, and follow the guidance provided in this user's guide for selecting the meteorological and source inputs to be used in the computer calculations. Because the model user must specify the parameter switches and meteorological data, care should be used to avoid inconsistent and physically unrealistic combinations of inputs. The use of incorrect parameter or meteorological input values as well as improper application of RTDM can result in serious calculation errors. Also, because the model provides many input and output options, the user should anticipate the necessity for making a number of trial program runs to become familiar with the various features of RTDM.

ABSTRACT

The Rough Terrain Diffusion Model (RTDM) version 3.20 is a sequential Gaussian plume model designed to estimate ground-level concentrations in rough (or flat) terrain in the vicinity of one or more co-located point sources. It is specifically designed for applications involving chemically stable atmospheric pollutants and is best suited for evaluation of buoyant plume behavior within about 15 km from the source(s). Model results for receptors beyond about 15 km can be used with caution to 50 km, and RTDM can be used as a screening model for distances beyond 50 km. RTDM has special algorithms to deal with plume behavior in complex terrain, and is especially suited for rough terrain applications.

While RTDM version 3.20 is specifically designed for use with sequential data sets, it can also be run in a case-study mode. Various optional features of the model make it useful for either research/sensitivity applications or routine evaluations of source compliance. RTDM has the ability to use hourly on-site measurements of turbulence intensity, vertical temperature difference, horizontal wind shear, and wind speed profile exponents. However, RTDM version 3.20 retains sufficient flexibility in the specification of model inputs to enable the user to obtain results similar to many other Gaussian point source models. The ability of RTDM to read hourly emissions data makes it useful for site-specific model evaluation studies.

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EXECUTIVE SUMMARY

The Rough Terrain Diffusion Model (RTDM) computer code provides a method to estimate air pollutant concentrations from multiple co-located sources in a rural environment. RTDM can be used in flat or complex terrain, but it is especially suited for use in complex terrain.

Special features employed by RTDM in estimating ground-level concentrations are listed below. For applications of the model in a mode approved for general use by the U.S. EPA, certain features are not used (see Section 5 for additional information).

- Reflection of plume mass from the ground is limited by the second law of thermodynamics, so that the maximum concentrations cannot increase with distance downwind.
- In stable conditions, a critical height (H_{crit}) is computed from the wind speed, the terrain height and the strength of the inversion. Plumes below this height are allowed to impinge on the terrain.
- The effects of buoyant entrainment can be accounted for in calculating plume size.
- Momentum effects on plume are ignored; only buoyancy-dominated sources should be modeled with RTDM version 3.2.
- Horizontal wind shear data can be used to make refined estimates of the horizontal extent of the plume.
- On-site turbulence intensity data (I_y, I_z), can be used as estimates of ambient dispersion for input to the model.
- The user can supply hourly values of the wind speed profile exponent.
- On-site values of vertical temperature gradients can be used to better estimate plume rise and H_{crit} values.
- In the presence of a mixing lid, the fraction of the plume that penetrates the lid can be calculated following Briggs (1975), rather than allowing either zero or total penetration of the lid.

- Transitional plume rise may be employed in model computations until the downwind distance to equilibrium plume height is reached by the plume.
- During neutral and unstable conditions or above H_{crit} in stable conditions, a "half-height" correction simulates the effect of terrain-induced plume modifications on ground-level concentrations.
- Decrease in plume rise due to stack-tip downwash can be accounted for.

RTDM can calculate ground-level concentrations at a maximum of 400 receptors from a maximum of 35 co-located point sources. Sources that are not co-located can be modeled separately with the same receptor grid (but different downwind distances to terrain), and the results can then be added using the postprocessor ANALYSIS program. RTDM calculates one-hour average concentrations, considering each hour as an individual steady-state period. The user can input hourly emissions parameters to the model. The resulting one-hour concentrations can be summed to obtain multiple-hour averages.

When the "partial reflection" option is employed in RTDM, the concentration at a receptor point depends upon the travel path of the plume (the upwind concentrations) as well as the location of the receptor itself. This is a feature found in few Gaussian models, and it requires the RTDM user to supply detailed terrain information in each of 36 directions (at 10° intervals). This terrain data consists of downwind distances to successive contour heights (at constant height intervals), starting below stack-top elevation and ending at the highest point within the distance from the source under consideration (e.g., 15 km). This terrain information is summarized in a table as well as presented in map form in the RTDM output.

1. INTRODUCTION

1.1 Model Features

RTDM version 3.20 is a sequential version of the ERT Rough Terrain Diffusion Model, and is based upon the case-study model, RTDM.WC, submitted to EPA in August 1980. The model can be used in flat or complex terrain, but it has features especially suited for simulating plume dispersion in complex terrain.

RTDM is a Gaussian, point-source model which has many parameters and optional features that allow for a wide variety of applications. These features are listed below:

- Wind Speed Determination:
    - Input of anemometer height
    - Adjustment of wind speed to stack top to compute plume rise
    - Use of a wind speed value at either stack-top or plume height for dilution
    - Use of an alternate observed wind speed value for dilution
    - Input of wind speed profile exponents: hourly or as a function of stability class
- Plume path adjustment as a function of Pasquill-Turner stability class
- Calculation of a dividing streamline height in stable conditions
- A choice of transitional or final plume rise
- A choice of dispersion parameters:
    - Pasquill-Gifford,
    - Briggs (1973)/ASME (1979),
    - User-supplied in the form $ax^b + c$
- Buoyancy-induced dispersion
- Stack-Tip downwash
- Multiple reflection from a mixing lid

- Partial plume penetration of a mixing lid
- An option to set the height of the mixing lid to 10,000 meters in stable conditions
- Optional meteorological input:

  - I_y, I_z to compute on-site σ_y, σ_z values
  - On-site vertical temperature difference data used to calculate stable plume rise and the height of the dividing streamline in stable conditions
  - Horizontal wind shear data to provide better estimates of σ_y

- In rough terrain, calculation of the maximum crosswind-integrated plume concentration upstream from each receptor location. The plume concentration is not allowed to increase with distance from the source. Reflection of the plume from the ground is limited to account for this effect.
- Use of hourly stack emissions data
- Maxima of 400 receptors and 35 co-located sources
- Transportable receptor grid of any configuration
- Sector-averaged or centerline concentrations calculated
- Detailed information can be supplied concerning plume behavior and dispersion in "case-study" mode
- Statistical and descriptive information supplied by postprocessor for various averaging times.

1.2 Steps Required to Run RTDM

Input Data

Use of RTDM requires the presence of the following input files:

- a file containing hourly meteorological data;
- optionally, a file containing hourly emissions data;
- a run stream file that specifies model options and gives source, receptor, and terrain information.

If both hourly meteorological data and hourly emissions data are used they must match chronologically for each hour modeled. Successive records of data that are not in an hourly sequence are flagged with a warning, but execution continues. Any number of data hours may be input to RTDM.

Model Execution Modes

RTDM version 3.20 can run in two modes: one with detailed printout for each receptor for each hour (verbose or case-study mode) and one without. In either case, concentrations are written to a disk file for postprocessing. The verbose mode produces a large volume of output, and it is recommended for short RTDM runs only.

Output Files

RTDM produces an output file to be printed that contains

1) a list of program options selected;
2) a list of key program parameters and their initialized values;
3) a description of the source characteristics;
4) a description of the receptor characteristics;
5) a description of the terrain surrounding the source (if using partial reflection).

The case-study mode also produces descriptive information about plume behavior for each hour for each source - receptor combination producing non-zero concentrations.

A disk file of computed ground-level concentrations is always produced. This disk file can be examined with the postprocessor ANALYSIS program.

1.3 Model Assumptions

Major assumptions in RTDM include:

1) The mean stack-top wind speed and direction are uniform in space and constant throughout the period of each concentration calculation (one hour).

2) When the effluent plume enters the atmosphere, it rises until it reaches an equilibrium altitude H.

3) At any downwind distance the distribution of concentration values away from the centerline is given by the product of two Gaussian distributions, one in the y direction (crosswind) and one in the z direction (vertical). A top-hat (sector-averaged) profile can be selected for the horizontal distribution.

4) The concentration profiles described by the Gaussian form are not "instantaneous" plume profiles; instead they represent concentrations averaged over a 1-hour period.

5) If the "partial reflection" option is not employed, it is assumed that all material in the plume is reflected by the ground. If the partial reflection option is used, the effect of full ground reflection is tracked along the plume up to the receptor point of interest. The maximum crosswind-integrated (MCWI) concentration is not allowed to increase with distance downwind. If the MCWI concentration starts to increase with full reflection, the "reflection factor" is "frozen" to prevent downwind increases. More details are provided in subsection 2.6.

6) The effluent rate and the meteorological parameters determining plume geometry are constant during each hour modeled.

7) Plume rise from point sources is calculated with Briggs' plume rise equations (Briggs 1969, 1973, 1975).

8) The effect of momentum (in the plume rise calculation) is ignored, as this is usually small compared to the effect of buoyancy. In this version of RTDM, only buoyancy-dominated sources may be used.

9) It is assumed that dispersion begins from a fictitious height above the actual source (effective stack height) instead of rising and dispersing simultaneously.

10) There are no provisions for building downwash or the merging of nearby buoyant plumes.

11) Both transitional and equilibrium plume rise are calculated.

12) The atmosphere is considered a single layer in the vertical (except for stable layers aloft) in which the rates of horizontal and vertical dispersion are independent of height.

13) The plume is completely reflected at the mixing height, as well as at the ground (except for partial reflection, if applicable) if the plume centerline is calculated to be below the mixing height.

14) Multiple reflection is simulated by means of a trapping model equivalent to that listed in the Turner Workbook, Equation 5-8, Page 36 (Turner 1969).

15) All of the plume mass is assumed to have punched through the mixing lid and to be in the stable layer aloft if the effective plume height is above the mixing lid (unless the partial plume penetration option is specified).

16) If the partial plume penetration option is used, then a fraction of the plume, P, (Briggs 1975) penetrates the mixing lid, and the Gaussian model equation is modified by multiplying the source emission rate by (1-P).

17) If the partial plume penetration option is specified and the penetration fraction P is $\geq$ .5, the final plume height is placed at the base of the elevated stable layer.

18) The simulation of buoyancy-enhanced dispersion is an option. (See subsection 2.7).

19) The simulation of stack-tip downwash is an option. (See subsection 2.9).

20) Although wind speed is measured at anemometer height, it is extrapolated to stack top for plume rise calculations by using a power-law wind speed profile. The dilution wind speed is taken to be either the stack-top speed or the speed at plume height. Extrapolation of wind speed with height levels off at a constant speed at or above 0.1 times the mixing height for unstable conditions, and at a height in meters of 200 multiplied by the 10-m wind speed (in m/sec) in neutral and stable conditions.

21) Hourly wind speeds below 1.0 meters per second (m/sec) are set to 1.0 m/sec. This precludes the possibility of concentration values approaching infinity as the wind speed approaches 0 and represents a lower wind speed limit to organized transport.

22) For calm conditions where there is no measured wind direction, the wind direction from the previous non-calm hour persists.
(NOTE - this can cause the model to overestimate pollutant concentrations for multiple-hour averaging times if conditions persist for several hours.)

23) Although RTDM defaults to the ASME (1979) dispersion parameters, the Pasquill-Gifford dispersion parameters or any parameters of the form $ax^b + c$ may be used.

24) If the distance from the source to a receptor is less than 10 meters, it is set to 10 meters for dispersion calculations.

25) Concentrations for a given hour are calculated independently of conditions for the preceding hours.

26) The total concentration determined for any receptor for one hour is the sum of the calculated concentrations for each source.

27) Average concentrations for time periods greater than one hour (as determined by the postprocessing program ANALYSIS) are computed by averaging the appropriate number of hourly concentrations.

28) RTDM can use hourly pollutant emission rate information as well as hourly stack temperature and exit velocity values.

29) Information concerning directional wind shear with height can be used to refine estimates of σ_y.

1.4 Applications and Limits of Use

RTDM has been designed for sensitivity studies, investigations, or for more routine applications, such as the determination of compliance with applicable air quality standards. It incorporates sufficient flexibility in its input specifications so that it can approximate the results of other Gaussian source models, such as EPA models used for complex terrain. It is best suited for applications at distances up to 15 km from the source, but may be used with caution out to 50 km, and as a screening model beyond 50 km.

RTDM has many options desirable for use in flat terrain, but it has special features suitable for use in complex terrain as well. The model can accept up to 35 sources, and is suitable for many routine multiple or single-source applications such as evaluation of control technology, stack-design investigations, prevention of significant deterioration, new source review, and source permitting applications.

RTDM may be run in a case-study mode, which allows the computation of concentrations for any number of selected one-hour periods, such as case-study hours for model validation, a set of hypothetical "worst-case conditions", or cases chosen to investigate the sensitivity of the model to variations in some input parameters or optional features of the model.

RTDM is quite useful for studies for which hourly monitoring data or hourly stack parameters (emission rates, temperature and exit velocity) are available. It can also use values of on-site meteorological data that improve estimates of σ_y and σ_z. RTDM version 3.20 is not able to simulate the behavior of momentum-dominated plumes. Also, it is not equipped to portray situations with complex aerodynamic effects due to nearby tall buildings.

This model assumes that the pollutants of interest disperse as non-reactive gases. There is no provision in RTDM version 3.20 for chemical transformation of plume constituents. No gravitational effects or depletion mechanisms, such as rain-out, wash-out or dry deposition, are considered.

In RTDM, the consideration of large downwind distances may involve a series of terrain obstacles in a given direction. Flow structure on the lee side of terrain obstacles can be more complicated than that on the windward side (Rowe, 1980). Thus, model calculations obtained for receptors on the leeward side of terrain should be interpreted with caution.

2. PHYSICAL PROCESSES MODELED BY RTDM

2.1 Gaussian Dispersion

The fundamental formula used in the model to estimate ground-level pollutant concentrations from a point source is the bi-variate Gaussian plume equation, as presented in the Workbook of Atmospheric Dispersion Estimates (Turner 1969). The general form of the equation is:

$$\chi(x,y,z) = \frac{Q}{2\pi\sigma_y\sigma_z u}\exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right] \cdot$$
$$\left\{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right] + \right. \tag{1}$$
$$\sum_{N=1}^{\infty}\left\{\exp\left[-\frac{1}{2}\left(\frac{z-H-2Nz_i}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H-2Nz_i}{\sigma_z}\right)^2\right]\right.$$
$$\left.\left. + \exp\left[-\frac{1}{2}\left(\frac{z-H+2Nz_i}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H+2Nz_i}{\sigma_z}\right)^2\right]\right\}\right\}$$

where

(x,y,z)	are the (downwind, crosswind, and vertical) coordinates of a receptor point in a Cartesian coordinate system, with the origin at the source location.
$\chi(x,y,z)$	is the pollutant concentration at receptor location (x,y,z) (mass/length^3);
H	is the effective height (stack height plus plume rise) of emission; that is, the centerline height of the plume (length);
Q	is the source strength (mass/time);

σ_y, σ_z are dispersion coefficients that are measures of crosswind and vertical plume spread, respectively. These two parameters are functions of downwind distance and atmospheric stability (length);

u is the average dilution wind speed (length/time); and

z_i is the height of the mixing lid (length).

In the model calculations, the downwind distance (x) and the crosswind distance (y) from the source to the receptor are determined as a function of the hourly wind direction, as well as source and receptor coordinates. The height of receptor points (z) above the ground is assumed to be zero in RTDM. However, non-zero values of z are employed in Equation 1 for the calculation of the maximum crosswind integrated concentration within the plume, which, in general, can occur at any point between the plume centerline height and the ground.

The source base is at z = 0 in the coordinate system. The most important assumptions on which the Gaussian plume formula is based are the following:

1) The mean stack-top wind speed and direction are uniform in space and constant throughout the one-hour period of each concentration calculation.
2) When the effluent plume enters the atmosphere, it rises until it reaches an equilibrium altitude H.
3) At any downwind distance, the distribution of concentration values off the centerline is given by the product of two Gaussian distributions, one in the y direction (crosswind) and one in the z direction (vertical).
4) The concentration profiles described by the Gaussian form are not "instantaneous" plume profiles; instead they represent concentrations averaged over an hour. Consequently, they incorporate the normal variability of wind flow for this time period.
5) In Equation 1, all material in the plume is totally reflected by the ground and the mixing lid. One model option, discussed in Section 2.6, involves a partial

reflection by these surfaces in order to prevent increases in the maximum crosswind-integrated plume concentration as the distance downwind increases.

6) The effluent rate and the meteorological parameters determining plume geometry are constant during the period of interest (that is, the equation represents steady-state conditions).

Equation 1 can be rewritten as

$$\chi(x,y,z) = \frac{Q}{u} \cdot \mathrm{HDF} \cdot \mathrm{VDF}, \tag{2}$$

where HDF, the horizontal distribution factor, is

$$\mathrm{HDF} = \frac{1}{\sqrt{2\pi}\sigma_y} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right], \tag{3}$$

and VDF, the vertical distribution factor, is

$$\begin{aligned}\mathrm{VDF} = \frac{1}{\sqrt{2\pi}\sigma_z} \Bigg\{ &\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right] + \\ \sum_{N=1}^{J} \Bigg\{ &\exp\left[-\frac{1}{2}\left(\frac{z-H-2Nz_i}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H-2Nz_i}{\sigma_z}\right)^2\right] \\ &+ \exp\left[-\frac{1}{2}\left(\frac{z-H+2Nz_i}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H+2Nz_i}{\sigma_z}\right)^2\right]\Bigg\}\Bigg\}\end{aligned} \tag{4}$$

where J is large enough to specify VDF to single precision computer accuracy (about 8 decimal digits). In RTDM, the multiple reflection part of VDF is expressed by a Fourier series, with only 2 terms required in the worst case to provide the desired accuracy.

Equation 3 represents the formulation of HDF for "off-centerline" calculations of the ground-level concentration. If sector averaging is used, HDF becomes 1/SW, where SW is the sector width at the downwind distance of the receptor.

If σ_θ data are to be used for the direct computation of σ_y, then the preferred choice for HDF is the off-centerline option. Sector averaging is an option for use with complex terrain applications. The use of sector averaging (conventionally 22.5 or 45°) accounts for the increased lateral turbulence often observed in the vicinity of high terrain. The horizontal distribution of concentrations is modeled as a top-hat shape rather than a Gaussian shape.

The wind speed, u, used in Equations 1 and 2, represents a dilution factor. Many Gaussian models use the wind speed at stack-top height to dilute the plume, but this practice may be inappropriate for buoyant plumes with a large rise distance. With RTDM, the user has the option to use the wind speed extrapolated to equilibrium plume height for dilution. This option is discussed in Section 2.3.

2.2 Plume Rise

The behavior of an effluent plume in the atmosphere is a complicated process, varying with conditions of release, wind, turbulence and numerous other factors associated with terrain and aerodynamics.

The typical stack plume is warmer than the surrounding air and the plume rise tends to be dominated by buoyancy. In this model, plume rise from point sources is calculated using the Briggs' plume rise equations (Briggs 1969, 1973, 1975). The effects of momentum are ignored because the rise due to momentum is usually small compared to that due to buoyancy. RTDM provides the capability of optionally including stack-tip downwash (see Section 2.8). However, there is no provision for building downwash or the merging of nearby buoyant plumes. Both transitional and equilibrium plume rise values are calculated. To simplify dispersion simulation, it is assumed that dispersion begins from a fictitious height above the actual source. This height, or 'effective stack height' is the sum of the actual stack height (h_s) and the plume rise from emission (Δh). For unstable and neutral conditions (stability classes 1, 2, 3, and 4), plume rise above stack top is computed by:

$$\Delta h = \frac{1.6F^{1/3}x^{2/3}}{u}, \quad x < 3.5x^*$$

$$\Delta h = \frac{1.6F^{1/3}(3.5x^*)^{2/3}}{u}, \quad x \geq 3.5x^* \tag{5}$$

where

F is the buoyancy flux of stack emissions in m^4/sec^3 = $gv_s d^2(T_s - T_a)/4T_s$,

where

v_s is exit velocity, d is stack diameter,
T_s is stack temperature, T_a is ambient temperature, and
x^* is the downwind distance at which atmospheric turbulence dominates entrainment in plume rise (m), given by,

$$x^* = 34.\ F^{2/5}, \quad \text{if} \quad F > 55\ m^4/sec^3;$$
$$x^* = 14.\ F^{5/8}, \quad \text{if} \quad F \leq 55\ m^4/sec^3;$$

$3.5x^*$ is the approximate downwind distance at which the plume becomes level (m).

For stable conditions (stability class 5 or 6):

$$\Delta h = \frac{1.6F^{1/3}x^{2/3}}{u}, \quad x < 2.07us^{-1/2}$$

$$\Delta h = 2.6\left(\frac{F}{us}\right)^{1/3}, \qquad x \geq 2.07us^{-1/2} \tag{6}$$

where

s is the stability parameter based on atmospheric lapse rate:

$$s = \frac{\partial\theta}{\partial z}\,\frac{g}{T_a} \tag{7}$$

and

$\partial\theta/\partial z$ is the rate of change of potential temperature with height (°Km^{-1}),

g is the acceleration due to gravity (9.8 m s^{-2}), and

T_a is the ambient temperature (°K).

For low wind speeds, the plume rise computed using

$$\Delta h = 5.0F^{1/4}s^{-3/8} \tag{8}$$

is used if the Δh value is lower than that obtained from Equation 6.

For stable conditions RTDM calculates plume rise using both the stable (equations 6 and 8) and the neutral (equation 5) formulas, and the conservative assumption is made (following Briggs, 1975) that the effective plume rise is the smallest value given by the various formulas.

2.3 Wind Speed Determination

The wind speed at stack-top elevation is used in the calculation of plume rise. Since the surface wind speed measurements are commonly taken at lower elevations than stack top, an adjustment is made in the model by the following power law relationship:

$$u(z) = u_r\left(\frac{z}{z_r}\right)^p \qquad (9)$$

where

$u(z)$ is the adjusted wind speed at stack height z;

u_r is the wind speed measured at a reference height z_r;

p is the wind profile exponent.

The profile exponent p is a function of stability class and has the default values given in Table 2-1 (DeMarrais, 1959).

In equation 9, the values of z and z_r are specified relative to a height, denoted here as z_a, from which the wind speed profile originates (the wind speed at height z_a is zero). In flat or gently rolling terrain, z_a is at the same height as the stack base elevation. In some rough terrain applications, however, the stack may protrude from a narrow valley or canyon. The wind profile above the canyon walls is often of primary interest for simulating plume transport and dispersion, and is often much different than the wind profile in the valley itself. If all of the model receptors are located on high terrain above the valley walls, use of a wind profile based upon a starting elevation some distance above the stack base elevation may be appropriate if actual wind measurements are taken at an elevation above plant grade. This height, z_a, must be at or above the common stack base used in RTDM, and should not be higher than the elevation of the top of the shortest stack (to prevent an undefined or negative stack-top wind speed). In the RTDM input parameter section, the origin height for the wind speed profile, z_a, is specified relative to its height above stack base. Its default value is zero.

As discussed in Section 2.1, the dilution wind speed can be chosen to be that at stack-top height or at plume height. The user should choose stack-top height if plume rise is typically low compared to the height of the stack. Otherwise, choice of the equilibrium plume height for the dilution wind speed may be more appropriate. RTDM can compute the dilution wind speed at plume height by

TABLE 2-1
WIND SPEED PROFILE EXPONENTS - DEFAULT VALUES

Stability Class	Wind Speed Profile Exponent, p
1	0.09
2	0.11
3	0.12
4	0.14
5	0.20
6	0.30

extrapolating the same wind speed value used to compute the stack-top speed. An alternative wind speed value (located at a height closer to equilibrium rise height, such as on a hill) can be used for extrapolation to plume height for the dilution calculation.

If multiple levels of wind speed on a tower are available, the user can choose to input hourly values of the wind speed profile exponent to RTDM. For many applications, a least-squares fit for the wind speed profile exponent is desired, such that the resulting profile matches the observations with a minimum of error. Of the measurement heights available, one should be selected as a reference height such that it is at or slightly above the stack-top height. If no measurements are taken as high as the stack-top height, the highest available wind speed data level should be designated as the reference level.

It is possible to apply the least-squares fit so as not to alter the wind speed measurement at the reference height. This option should be used if the data are reliable at the reference level and its position relative to other tower levels is superior for use in calculating plume rise. If, however, some data at the reference level are missing or that level is not clearly superior to other levels, then the reference level speed should be determined from all available measurements. The procedures to be used for calculating hourly wind speed profile exponents according to the two methods are explained below.

If the reference level wind speed measurement is to be retained, define p, the wind speed profile exponent, as follows:

$$p = \frac{\sum_{i=1}^{N} \left[\ln\left(\frac{u_i}{u_r}\right) \cdot \ln\left(\frac{z_i}{z_r}\right) \right]}{\sum_{i=1}^{N} \left[\ln\left(\frac{z_i}{z_r}\right) \right]^2} \qquad (10)$$

where

i refers to individual height levels

N is the number of levels,

u_i is the wind speed at the i^{th} level,

z_i is the height of the i^{th} level, relative to height z_a

r refers to the reference level.

If the reference level wind speed measurement is to be estimated from all available data, define p as:

$$p = \frac{N \sum_{i=1}^{N} \left[\ln(u_i) \cdot \ln\left(\frac{z_i}{z_r}\right) \right] - \left[\sum_{i=1}^{N} \ln(u_i) \right] \cdot \left[\sum_{i=1}^{N} \ln\left(\frac{z_i}{z_r}\right) \right]}{N \sum_{i=1}^{N} \left[\ln\left(\frac{z_i}{z_r}\right) \right]^2 - \left[\sum_{i=1}^{N} \ln\left(\frac{z_i}{z_r}\right) \right]^2} \tag{11}$$

and redefine u_r (used as input to RTDM in the hourly meteorological data) as

$$u_r = \exp\left[\frac{\sum_{i=1}^{N} \ln(u_i) - p \sum_{i=1}^{N} \ln\left(\frac{z_i}{z_r}\right)}{N} \right] \tag{12}$$

An example of the application of both methods to the same data set is given in Table 2-2.

Several observers (Arya, 1982; Kaimal et al., 1976; Pennell and Le Mone, 1974; Clarke, 1970; Izumi and Barad, 1963) have noted that the wind speed does not obey a power law (Equation 9) throughout the entire boundary layer, whose height is defined by the mixing lid. Instead, the increase of wind speed with height is found to level off or even slightly decrease above a certain height, depending upon the mixing height in unstable conditions or the surface layer friction velocity, u_*, in neutral and stable conditions. The calculation of height limits above which the wind speed is assumed to be constant is a feature that has been incorporated into RTDM. In unstable conditions, the height limit is 0.1 times the mixing height. Arya

TABLE 2-2

EXAMPLE OF LEAST-SQUARE DETERMINATION OF WIND SPEED PROFILE EXPONENT

Wind Speed Measurement Levels (m)	Measured Wind Speeds (m/sec)	Calculated Wind Speeds, Method 1*	Calculated Wind Speeds, Method 2*
10	2.0	1.96	1.97
50	4.0	4.05	4.11
80 (reference level)	5.0	5.00	5.09
150	7.0	6.63	6.79
75**	–	4.86	4.94
		p=0.4497	p=0.4570

---

*Method 1 retains the wind speed measurement at the reference level (80 m), Method 2 does not impose this restriction.

**In this example, 75 m is the stack-top level, for which a calculated wind speed is desired.

(1981) shows that in neutral and stable conditions, the approximate height of the wind speed maximum (H_{max}) is given by

$$H_{max} = 0.142 \frac{u_*}{f}, \tag{13}$$

where u_* is the friction velocity, and f is the Coriolis parameter.

For general application, H_{max} can be specified approximately using a 10-m wind speed with assumptions for typical values of surface roughness length in complex terrain (1 meter) and the Coriolis parameter (10^{-4}sec^{-1}). The resulting values of H_{max} as a function of stability are:

$$\begin{aligned} H_{max} &= 0.1 \cdot \text{mixing height for unstable conditions} \\ H_{max}\ (\text{meters}) &= 200 \cdot \text{10-m wind speed (m/sec) for} \\ &\qquad \text{neutral and stable conditions} \end{aligned} \tag{14}$$

Equation 9 is therefore modified for RTDM as follows:

$$u(z) = u_r \left(\frac{z_{max}}{z_r} \right)^p, \tag{15}$$

where $z_{max} = z$ if $z < z_r$,
$z_{max} = \min(z, H_{max})$ if $z > z_r$.

Pollutant concentrations estimated by the Gaussian plume equation used in the model are inversely proportional to average wind speed. This relationship implies that concentrations would approach infinity as the wind speed approaches zero, which is clearly not the case. To simulate the effects of very low wind speed cases, hourly wind speeds that are below 1.0 m/sec are set at 1.0 m/sec. This precludes an invalid application of the model. For calm conditions where there is no measured wind direction, the wind direction from the previous non-calm hour persists. This assumption can cause the model to overestimate pollutant concentrations for multiple hour averaging times if calms persist for several hours.

2.4 Stability Category

The user must specify a stability category for each hour of meteorological input. Stability category values range from 1 to 6 and represent the following conditions:

1 - Very unstable
2 - Moderately unstable
3 - Slightly unstable
4 - Neutral
5 - Slightly stable
6 - Moderately to very stable

In RTDM, the stability category can be used for several computations:

1) The formula for plume rise is a function of stability class. Different calculations take place for stable and non-stable hours. However, if on-site vertical temperature difference data exist, the use of stability class can be completely eliminated. In such a case, neutral/unstable rise is assumed for negative or zero vertical potential temperature gradients (VPTG). For positive (stable) values of VPTG, both neutral and stable rise formulas are evaluated, and the lower rise is chosen.
2) The behavior of a plume encountering terrain is a function of the stability class. The choice of the plume path correction factor is usually different for stable versus non-stable conditions. However, if hourly vertical potential temperature gradient values (for determining H_{crit}) are available, these data values can be used to distinguish between stable and nonstable conditions. In stable conditions, the VPTG value is used to calculate

H_{crit}, which is used to determine whether or not the plume is allowed to impinge upon the terrain.

3) Values of σ_y and σ_z are conventionally a function of stability class. This dependence upon stability class can be eliminated (except for selection of a formula for computing the growth of σ_z as a function of distance) by supplying turbulence intensity data (I_y, I_z). The turbulence intensity data (or sigma-theta/ sigma-phi values) can then be used to calculate σ_y and σ_z directly (Hanna et al. 1977).

4) The determination of the wind speed profile exponent is a function of stability class if hourly values are not supplied. The specification of hourly values (Section 2.3) is not a function of stability. However, determination of H_{max} (Equation 14) is weakly dependent upon the stability class.

Depending upon the availability of on-site meteorological measurements and the options selected, the RTDM user may rely heavily or very little upon stability class values in the calculation of ground-level concentrations. The use of as much on-site data as possible in the model computations (Strimaitis et al. 1980) decreases reliance upon the accurate specification of stability class values.

2.5 Dispersion Parameters

The parameters σ_y and σ_z, which represent the crosswind and vertical standard deviations of the dispersing plume, are functions of x and are related to meteorological conditions. These two variables provide the Gaussian equation with some flexibility, as σ_y and σ_z may be obtained by various methods without altering the original computation scheme.

In RTDM, values of σ_y and σ_z may be determined from stability class or from hourly values of the vertical and horizontal components of the turbulence intensity. If the stability class method is used, the user can choose to calculate σ_y and σ_z in one of the following ways:

- by using Pasquill-Gifford dispersion coefficients,
- by using Briggs rural (ASME, 1979) dispersion coefficients,
- by using dispersion coefficients supplied in the form $ax^b + c$, which may vary as a function of stability class and downwind distance ranges.

RTDM has been designed to accommodate the use of on-site turbulence intensity data (or sigma-theta, sigma-phi values), if available. The formulation of σ_y and σ_z from these data closely follows Briggs (1973):

$$\begin{aligned} \sigma_y &= I_y \cdot x \cdot (1 + 0.0001\,x)^{-1/2}, \; x < 10{,}000 \text{ m}, \\ \sigma_y &= I_y \cdot x \cdot (1/\sqrt{2}), \; x \geq 10{,}000 \text{ m} \end{aligned} \tag{16}$$

where σ_y and x are in meters, I_y is the horizontal component of the turbulence intensity (or sigma-theta expressed in radians). The formula for σ_z depends upon stability category:

$$\begin{aligned} \sigma_z &= I_z \cdot x \text{ for unstable conditions,} \\ \sigma_z &= I_z \cdot x \cdot (1 + 0.0015x)^{-1/2} \text{ for neutral conditions,} \\ \sigma_z &= I_z \cdot x \cdot (1 + 0.0003x)^{-1} \text{ for stable conditions,} \end{aligned} \tag{17}$$

where σ_z and x are in meters, I_z is the vertical component of the turbulence intensity (or sigma-phi expressed in radians).

If only one of either I_y or I_z is available, RTDM can still be run with the observed turbulence values to determine σ_y or σ_z (whichever is appropriate), and the stability class can be used to determine the other sigma value. The Pasquill-Gifford and ASME curves are based upon Pasquill-Turner stability classes. In general, the authors recommend for "refined" modeling that if either sigma-theta or sigma-phi values near stack-top height are available and determined to be of acceptable quality, those data should be used in the direct calculation of σ_y or σ_z. However, a "default mode" version recommended by EPA for general use as a screening model determines σ_y and σ_z indirectly using the stability class.

Instrumentation used to obtain σ_θ and especially σ_w measurements must be given careful attention in terms of maintenance and quality assurance. Use of poor quality turbulence data in RTDM can be worse than indirect calculation of σ_y and σ_z from stability class values. These turbulence input parameters require careful checking. The siting of the tower to obtain turbulence behavior representative of that experienced by the plume is important as well as following EPA recommendations regarding on-site instrumentation (Strimaitis et al, 1980 and EPA, 1987).

2.6 Partial Plume Reflection from Sloping Terrain

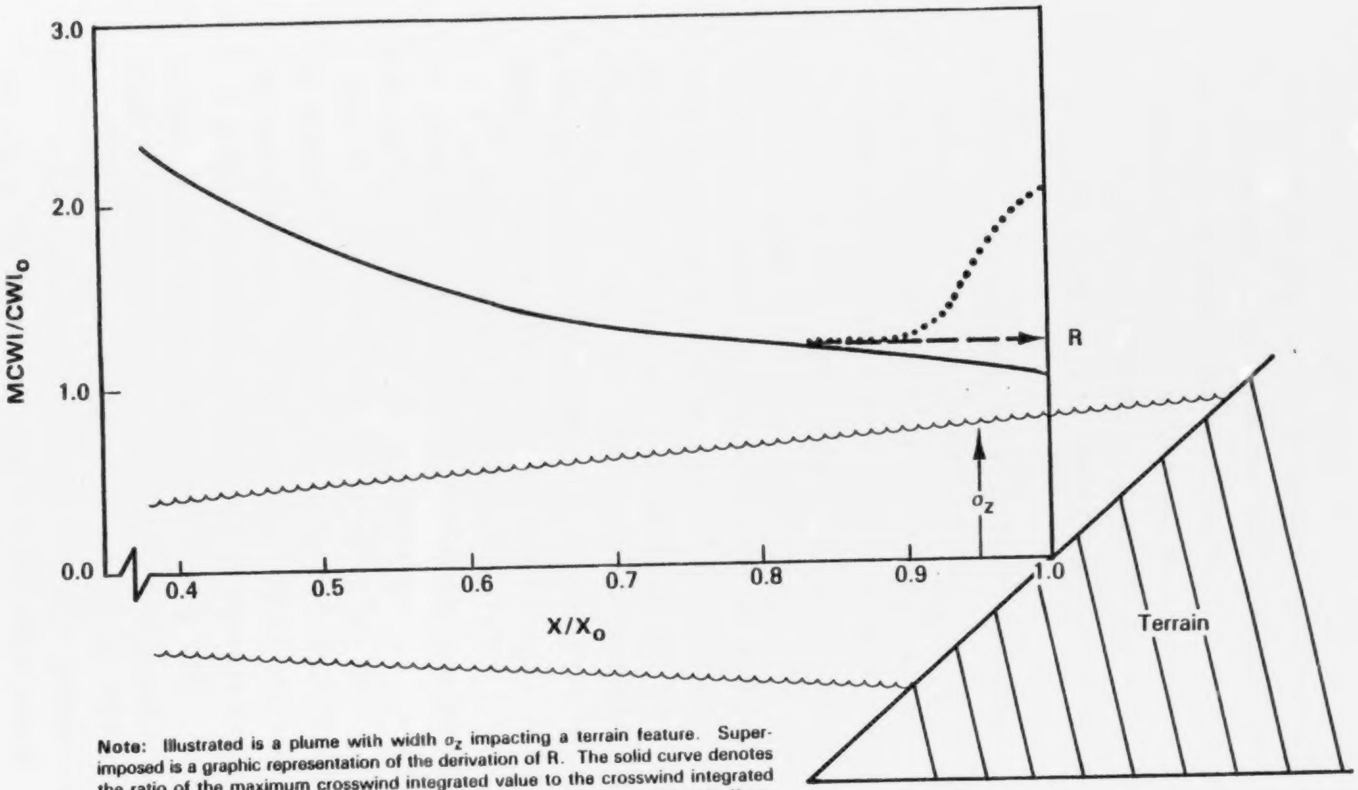
As an elevated plume flows over flat terrain, material within the plume diffuses in all directions. The presence of the ground surface prevents the diffusion of inert gaseous materials through the surface. This has been conventionally modeled by assuming an "image source" below the surface. At the surface itself, the mathematical result is a doubling of ground-level concentrations due to "reflection" of material associated with the image source, a reasonable approach for flat terrain.

In contrast, when an elevated plume flows toward high terrain, the application of a Gaussian plume model with full reflection may not be appropriate. For example, consider the extreme case of a plume approaching a vertical surface: a short distance upwind of the vertical surface, the effects of ground reflection on the peak concentrations which occur along the plume axis may be minimal. However, when the plume impacts the vertical surface, the conventional reflection algorithm doubles the plume axis concentrations over those slightly upwind.

This conventional algorithm is inadequate in such a situation because concentrations within a plume cannot double over values that exist immediately upwind: diffusion processes must always act to dilute the maximum concentrations within a plume, and therefore, the peak concentrations in the plume cannot increase simply by approaching a surface. Such an increase would violate the second law of thermodynamics, which states, in effect, that if the flow conserves mass, concentrations cannot increase with increasing time of transport.

The principle that the peak concentrations within a plume cannot increase with increasing travel time (assuming a constant emission rate) provides a framework for estimating the maximum effect of reflection for a plume approaching a terrain slope. The effect of reflection is independent of dispersion in the crosswind direction. If the flow is not systematically converging or diverging in the region of interest, it is appropriate to consider the behavior of the crosswind integrated concentration values as a plume approaches a terrain slope.

Figure 2-1 illustrates a vertical cross-section of a plume approaching a terrain slope. In the absence of the surface, the maximum crosswind integrated concentration (MCWI) within the plume will occur at the plume axis and will continuously decrease with downwind distance (solid line). An overestimate of the effect of reflection can be made by calculating the maximum crosswind integrated concentration as a function of downwind distance (denoted by MCWI(x)), assuming full reflection from the terrain surface below the plume. As a conservative approach, the model assumes that the plume trajectory is unaltered by the presence of the terrain. For sufficiently steep slopes, the MCWI(x) so calculated will reach a minimum value upwind of the impact location ($x = x_o$) and will increase with further distance downwind (dotted line). This increase is prohibited, however, as discussed above, by the second law of thermodynamics. Therefore, this minimum value of the MCWI(x) provides a value that cannot be exceeded further downwind (i.e., at the point of impact). The ratio of this minimum value of the MCWI(x) to the CWI at the location of impact or the closest plume approach to the terrain ($x = x_o$) evaluated for the plume centerline in the absence of the terrain effects is called R, the reflection factor. This value of R depends on the given slope of the terrain and the plume growth rate. The estimate of MCWI(x) must consider that the maximum concentration within the plume is not necessarily at the original position of plume centerline: as reflection effects become more important, the maximum approaches the surface.



Note: Illustrated is a plume with width σ_z impacting a terrain feature. Superimposed is a graphic representation of the derivation of R. The solid curve denotes the ratio of the maximum crosswind integrated value to the crosswind integrated concentration at $x = x_o$ for a plume unaffected by terrain. The calculated effects of reflection cause the MCWI/CWI$_o$ to increase as the plume approaches the slope (dotted curve) to a value of 2.0. The second law of thermodynamics limits the actual increase possible to the minimum value of the dotted curve (dashed line to ordinate value). The ratio at this point is the value of R.

Figure 2-1 Derivation of Reflection Factor, R, for a Level Plume Impacting Sloping Terrain

From the Gaussian plume formula and assuming full reflection effect from the terrain immediately below, CWI(x,z) can be calculated from:

$$CWI(x,z) = (Q/u) \cdot VDF \tag{18}$$

To find MCWI(x), the maximum value of CWI(x,z) at each downwind location must be determined. In practice, RTDM does not evaluate reflection effects until the plume centerline is less than 2.15 σ_z from the terrain surface (Turner, 1969, Chapter 3). From that point on, the CWI(x,z) is calculated at between the ground and the plume centerline at 5 height intervals. At each downwind distance, the maximum CWI value (MCWI) is obtained. The MCWI is evaluated at 10 or fewer downwind distance increments between the point where the plume is within 2.15 σ_z of the surface and the location of the plume impact or closest approach (or the receptor point in question, if it is encountered first). The minimum value of MCWI is determined and the reflection factor, R, is calculated as shown in Figure 2-1 ($R = \sqrt{2\pi}\sigma_z \cdot MCWI$).

RTDM incorporates this method to estimate the reflection factor. The RTDM code currently sets a minimum value of 1.00 for R. Ground-level concentrations are then determined by the smaller of (a) the centerline concentration at the specified downwind distance, with the calculated reflection factor or (b) the ground-level concentration with full reflection at the same downwind location. The value of VDF in Equation 2 is set to the lesser of $R/(\sqrt{2\pi}\sigma_z)$ or the full reflection value given by Equation 4. For receptors where the plume encounters little or no terrain, the full reflection result will be used by the model.

2.7 Buoyancy-Enhanced Dispersion

For strongly buoyant plumes, the dominant contributions to their growth as they rise to stabilization height is often the entrainment of ambient air induced by the vertical motion of the plume relative to the ambient air. The buoyancy effect is supported by both the photographic data and the theoretical considerations on which the

Briggs plume rise formulas are based. Incorporation of this "buoyant enhancement", therefore, avoids an inconsistency shared by many standard Gaussian models that use the plume rise formulas of Briggs, while retaining the estimates of vertical plume spread derived from observations of non-buoyant releases. This enhanced plume growth is implemented by the relationship (Pasquill 1976)

$$\sigma = \frac{\Delta h}{\sqrt{10}} \tag{19}$$

where Δh is the final plume rise. The expression above is derived from the assumption that a rising plume is evenly mixed ("top hat") and circular in section and that the entrainment coefficient is approximately 0.55. Consequently, this formulation of plume enhancement is applied to both σ_y and σ_z in the same way.

It is assumed that the enhanced plume growth due to buoyancy is independent of ambient turbulence. Therefore the resultant values of σ_y and σ_z can be expressed (Pasquill, 1976) as the square roots of the sum of the squares of the individual components: $\sigma = (\sigma_a{}^2 + \sigma_b{}^2)^{1/2}$, where σ_a is due to ambient turbulence and σ_b is due to plume buoyancy.

2.8 Horizontal Wind Shear

Differences in the wind direction within the height interval occupied by the plume will act to increase the horizontal spread of the plume. Pasquill (1976) has suggested a formula for the shear component of σ_y:

$$\sigma_{ys} = 0.17 \cdot \Delta\theta \cdot x \tag{20}$$

where Δθ is the wind direction change over the plume depth, which is assumed to be approximately the same as the plume rise (Briggs 1975). The resultant value of σ_y computed from the effects of ambient turbulence (σ_{ya}), buoyancy-enhanced dispersion (σ_{yb}) and horizontal wind shear (σ_{ys}) is

$$\sigma_y = (\sigma_{ya}^2 + \sigma_{yb}^2 + \sigma_{ys}^2)^{1/2} \tag{21}$$

Meteorological data used to compute horizontal wind shear involves two levels of wind direction measurements. These levels should be as close to plume height as possible. The user should avoid measurement heights that are either a) too low or b) too close together (these could result in an overestimate of the shear at the plume level). This model feature is designed for use in refined modeling applications, and is not included in screening modes.

2.9 Stack-Tip Downwash

The aerodynamic flow near the top of a stack can depress the initial plume height by an amount that depends on the ratio of wind speed to exit velocity. The subsequent rise computed by some methods is that part of the rise occurring from x* to 3.5x*, where x* is the downwind distance at which ambient turbulence exceeds plume-penetrated turbulence. Since x* only depends on the buoyancy flux (see Equation 5), and the initial plume depression is only a few meters at most, the final plume height is essentially independent of the ratio of wind speed to exit velocity in stack downwash conditions and is abruptly discontinuous at the threshold ratio. A more realistic approach contains the following principal points:

1) The degree of downwash is a continuous function of wind speed once a threshold value of the ratio of plume exit velocity to wind speed at stack height is reached.
2) The loss of plume rise is associated with: (1) a physical downward displacement caused by the stack (after Briggs 1975) and (2) an increase of the plume cross sectional area caused by downwash that reduces the initial rate of rise.

Briggs (1975) gave the following expression for the initial depression of the plume centerline (Δh') below stack top during downwash conditions

$$\Delta h' = 2(1.5 - \frac{W}{U})\ D \text{ for } \frac{W}{U} \leq 1.5 \qquad (22)$$

where D is the stack diameter, W is the plume exit velocity, and U is the horizontal wind speed. This equation suggests that the initial depth of the plume under downwash conditions is 4(1.5 - W/U)D. If the initial plume width is given by D, the initial cross sectional area of the plume may be approximated by $4(1.5 - W/U)D^2$.

The Briggs plume rise formulas incorporate the empirical evidence that indicates that plume rise for a point source is equal to plume depth. This is the basis for Briggs entrainment coefficient of 0.5. A downwashing plume has an initial cross section, i.e., it can no longer be considered to emanate from a point source. Since no rise is associated with the initial plume depth, some means to reduce the predicted plume rise correspondingly is desirable. Briggs' observation of the equivalence between plume rise and plume depth may be invoked to estimate the necessary correction. A non-downwashing plume from a virtual source upwind of the stack would rise a distance Δh" during the time required to attain a cross sectional area of $4(1.5 - W/U)D^2$. Assuming a circular cross section, Δh" can be estimated from the diameter of this cross section, i.e.,

$$\Delta h'' = \left(\frac{8AD}{\pi} \right)^{1/2} \qquad (23)$$

where

$A = 2(1.5 - W/U)D \quad \text{if} \quad W/U \leq 1.5$

$A = 0 \quad \text{if} \quad W/U > 1.5$

Thus, the plume rise formula used in RTDM during downwash conditions is given by:

$$\Delta h = \Delta h_o = \Delta h' - \Delta h''$$

$$= \Delta h_o - A - \left[\frac{8AD}{\pi}\right]^{1/2} \tag{24}$$

where Δh_o is the plume rise without downwash.

Since this option affects final plume rise, it has an effect upon other options, such as buoyancy enhancement of plume dimensions, partial plume penetration, and behavior of the plume in terrain.

2.10 Plume Path Correction Near Terrain

To account for the possible distortion of the plume trajectory as the plume approaches terrain, RTDM uses a "plume-path coefficient", C, to modify the height of the plume above the ground. The value of C can conceivably range from 0, for a level plume, to 1 for a plume that remains the same distance above the ground in all terrain. The plume-path coefficient is set by default to 0.5 for all stabilities, but it is a site-specific parameter which ideally would be determined on the basis of meteorological conditions and terrain shape.

In stable conditions, the plume may not have enough kinetic energy to climb over a terrain obstacle. As discussed by Hunt et al., (1979), Snyder et al., (1979) and Rowe (1980), a critical height, H_{crit}, can be defined such that only the air above this level will move over a terrain feature. Plumes at or below this height will impinge upon the terrain. H_{crit} is defined as:

$$H_{crit} = H\ (1-F_r), \tag{25}$$

where

H is the height of the terrain obstacle (above stack base elevation),

F_r is the Froude number $= u/(Hs^{1/2})$; (26)

u = the stack-top wind speed,

T_a = ambient temperature,

s = $\frac{g}{T_a} \frac{d\theta}{dz}$, and

$\frac{d\theta}{dz}$ = VPTG = vertical potential temperature gradient.

The computation of Froude number is simplified here by assuming constant values for u and s between the stack top and the top of the hill.

The value of VPTG used for calculations of H_{crit} may be different than the value of VPTG used for plume rise, due to the different locations of the stack and the terrain obstacle. RTDM allows the user to specify hourly values of these values of VPTG separately, if such data are available.

In unstable and neutral conditons, H_{crit} is zero. For stable conditions, the air below H_{crit} stagnates and moves around rather than over a terrain obstacle. Air parcels just above H_{crit} have barely sufficient kinetic energy to reach the crest of the terrain. Accordingly, the adjustment of the plume height above terrain is formulated in RTDM as follows:

$H_a = C \cdot H_{pc}$ if plume height is less than or equal to local terrain height, (27)

$H_a = H_{pc} - (1-C)\, H_{tc}$ if plume height is above local terrain height,

where

H_a is the adjusted plume height above local terrain,

H_{pc} is the height of the plume above H_{crit}

H_{tc} is the height of the local terrain above H_{crit}

C is specified plume path coefficient as a function of stability class, set to zero on an hour-by-hour basis if $H_{pc} < 0$.

If the plume is above H_{crit} and the receptor is below H_{crit}, the use of a nonzero value of C would result in the plume dropping below its final height at the receptor location because H_{tc} is negative. To avoid an artificial plume depression, RTDM assumes a level plume (C = 0) for cases in which the plume is above H_{crit} and the receptor is below H_{crit}.

Examples of the terrain adjustment in stable conditions are shown in Figure 2-2. Default values for C are 0.5 for all stability classes.

To avoid an inconsistent adjustment of plume height and mixing height, RTDM adjusts the mixing height z_i in terrain as follows:

$$z_i^* = C \cdot (z_i - H_{crit}) \text{ if } z_i < \text{local terrain height,}$$

$$z_i^* = (z_i - H_{crit}) - (1 - C)(H_{tc}) \text{ if } z_i > \text{local terrain height} \quad (28)$$

where z_i* is the adjusted mixing height.

If the hill height changes rapidly as a function of azimuth relative to the source, H_{crit} can vary rapidly as well. Therefore, if sector averaging is used and changes in wind direction alter the receptor position within the sector, calculated concentrations will change if H_{crit} changes at the plume centerline. RTDM uses a "unified" plume treatment (the central H_{crit} applies for all receptors), assuming that the plume is controlled by H_{crit} along the centerline until it gets close to the hill. In the absence of turbulence measurements in the vicinity of terrain, the sector averaging treatment accounts for increased lateral turbulence near the terrain features that is not incorporated in the σ_y formulas.

2.11 Partial Plume Penetration of an Elevated Inversion

Most present Gaussian air quality models treat the stable stratification above the mixing layer as either a perfect reflector or perfect absorber of a rising plume. If the predicted final plume height in a neutral atmosphere is higher than the mixing height, the entire plume is assumed to penetrate the stable lid, thus not contributing to ground-level concentrations. Otherwise, final plume height is limited by the mixing depth and the plume is reflected at that height. This binary mode of modeling of plume behavior is not a

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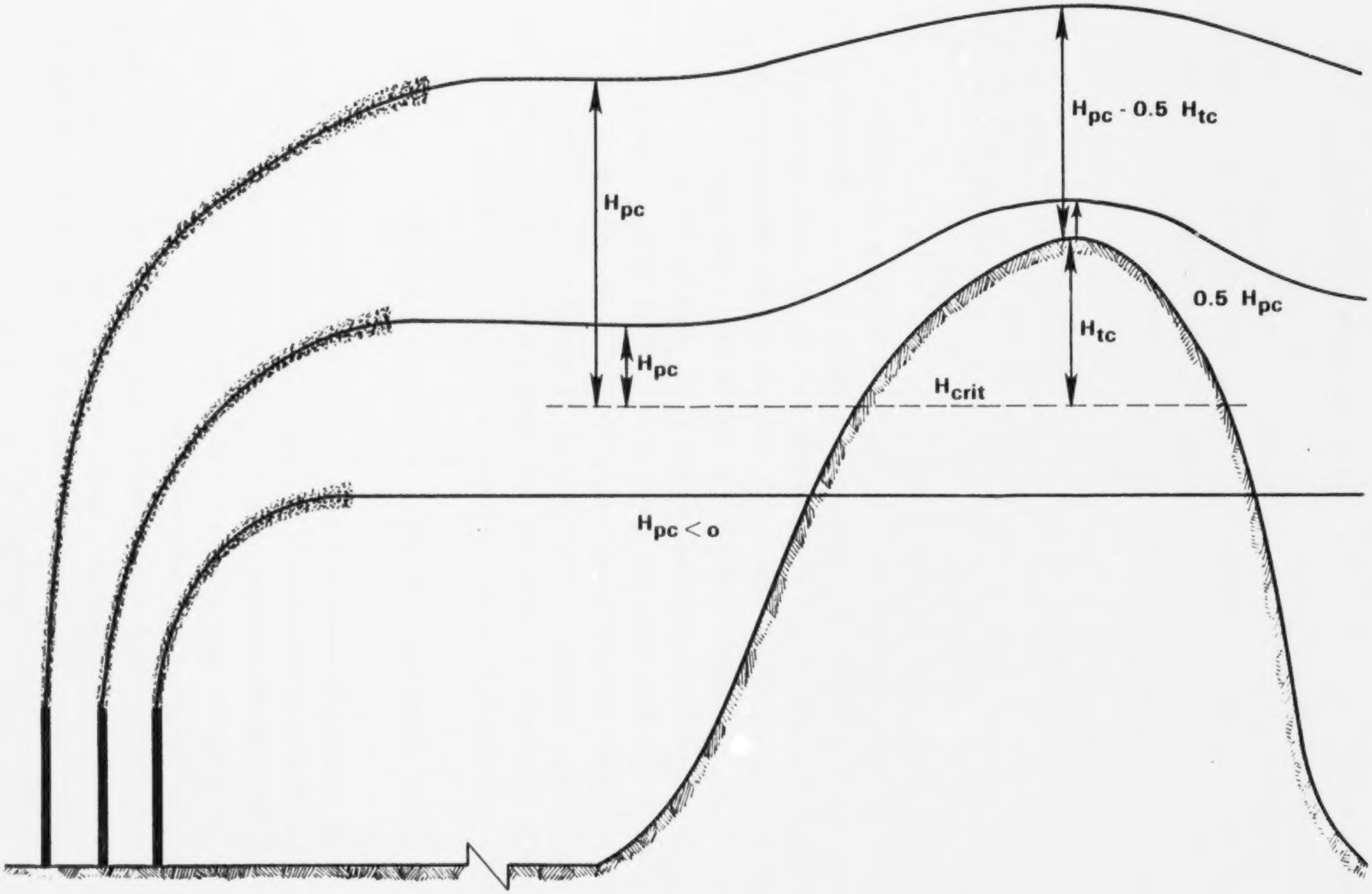
H_{pc} - 0.5 H_{tc}
H_{pc}
0.5 H_{pc}
H_{tc}
H_{pc}
H_{crit}
$H_{pc} < o$

Figure 2-2 Plume - Terrain Interaction Under Stable Conditions Assuming Plume Path Coefficient = 0.5

very realistic approximation and in some cases can lead to serious errors in concentration predictions.

RTDM allows for the simulation of a more intermediate situation with the selection of the partial plume penetration option. This is based on the work of Briggs (1975), who proposed a more physically realistic approximation of plume interaction with the stable lid based on solutions to the buoyancy flux equation for a bent-over plume. The lapse rate of the stable layer is accounted for in the Briggs scheme.

Briggs defines the fraction of the total plume mass to penetrate the stable layer as the penetration factor

$$P = (\text{depth of plume above } z_i)/(\text{total plume depth})$$

$$P = (1.5\ z_e - z_i)/(1.5\ z_e - 0.5\ z_e) \qquad (29)$$

where z_i is the height of the mixing lid above stack height and z_e the equilibrium plume rise. The equilibrium plume rise is the height at which the plume buoyancy flux, F_z, equals zero. The plume depth (after Briggs [1969]) is assumed to equal the plume rise. The parameter, s, is taken as a measure of the stability of the elevated inversion:

$$s = g/T_a \cdot \text{VPTG} = \text{constant in that layer.}$$

For a neutral mixed layer, $s = 0$. During plume penetration, s is not constant over the whole depth of the plume. The mathematics dictate that for this case the magnitude of s at any given level in the buoyancy flux equation is weighted by the total upward flow within the plume at the level. Briggs assumes a simple rectangular approximation as the weighting function of s, which is equivalent to assuming a rectangular top-hat plume profile with a constant upward velocity inside.

Following Briggs and integrating through the traverse of z_i by the plume to find the centerline height at which $F_z = 0$, the result is

$$\left(\frac{z_e}{z_b}\right)^2 \left(\frac{z_e}{z_b}\right) - 1 = \frac{2F}{\beta^2 U s z_b^3}\left(\frac{M_{eff}}{M}\right) - \frac{4}{27} \qquad (30)$$

where U is the constant horizontal wind speed determined at stack height, M_{eff}/M, the ratio of the effective vertical momentum flux to the internal vertical momentum of the plume, and β, the factor that when multiplied by plume rise yields the radius of an equivalent circular plume. The value of β is assumed equal to 0.6. The effective vertical momentum flux includes the effects of the air displaced by the plume. On the basis of observations of streamlines around two dimensional thermals, Briggs assumes M_{eff}/M has the value 2.25. The above equation can be rewritten as:

$$\left(\frac{z_e}{z_i}\right)^3 - \left(\frac{z_e}{z_i}\right)^2 - \left(C - \frac{4}{27}\right) = 0 \qquad (31)$$

This is now a cubic in (z_e/z_i), and the quantity (z_e/z_i) can be solved by using the standard analytic solution. The plume penetration factor is then calculated from (27).

After computing the penetration factor P, the multiply reflecting Gaussian model equation is modified by multiplying the source emission rate, Q, by the factor (1-P). If $P \geq 0.5$ $(z_e \geq z_i)$, then the final plume height is placed at the base of the stable layer for computing the ground level concentrations caused by the non-penetrating portion of the plume. If $P > 0.5$, then final plume height is below z_i and the usual Gaussian computations apply for the (1-P) fraction of the plume. The portion of the plume predicted to penetrate the stable layer, P, is ignored.

If the option for partial plume penetration is not selected, either total penetration or no penetration is simulated. The plume is assumed to completely penetrate the inversion if the plume centerline height is greater than the mixing height. With full penetration, the penetration factor, P, is set to 1. If the plume centerline height is less than the mixing height, then it is assumed that no penetration occurs $(P = 0)$. The use of the partial penetration algorithm does not affect any plume rise calculations.

The choice of a unique VPTG for the elevated inversion is required by RTDM. A value of 0.006 °K/m, suggested by Carson (1973) and Tennekes (1973), is recommended.

2.12 Use of On-Site Values of Vertical Temperature Difference

RTDM will accept hourly values of the vertical potential temperature gradient (VPTG) for use in computing plume rise and the value of H_{crit}. These two values of VPTG need not be the same. For plume rise, measurements of ΔT near stack top are desired. For H_{crit}, values obtained near the terrain of interest are useful. If neither value is supplied, stability-dependent default values are used for each hour modeled.

Measured values of ΔT from towers much shorter than the stacks to be modeled can lead to significant overestimates of VPTG, because the most intense temperature gradients are found near the surface. For example, Egan et al. (1985) examined site data where a comparison of airborne vs. tower measurements was conducted. They found that temperatures near the valley sides were cooler than those at the same elevations at a location away from the valley walls, a radiation-caused phenomenon. This led to overestimates of VPTG if a single short tower were used, even on elevated terrain. Therefore, ΔT data obtained from relatively short towers or from low heights (less than perhaps 30 m) on meteorological towers should not be used.

2.13 Source/Receptor Relationships

RTDM allows the user to specify up to 35 point sources, which must be co-located (or nearly so) with the same stack base height. Sources that are not co-located can be run separately, and the resulting concentrations subsequently added by the postprocessor.

The steady-state assumption and dispersion coefficients used by RTDM and other Gaussian air quality models are generally most valid for transport distances up to 15 km from a source. However, these models can be applied for distances up to 50 km with caution (see

Guideline on Air Quality Models (Revised), 1986). Steady-state Gaussian models such as RTDM are conservative at distances beyond 50 km, and therefore may be used for screening purposes.

The user may specify any number of receptors up to a maximum of 400. These may be placed in any desired configuration and are identified by their X and Y coordinates, usually given in UTM. (An input factor exists to scale any input units to meters). It is important to realize that input limitations may affect receptor specification. For instance, if input wind direction values are given to the nearest 5°, the predicted concentration values are most reliable at receptors placed on 5° radials from the source location. However, if wind direction is input to every degree, any receptor coordinates are reasonable.

2.14 Specification of Terrain Surrounding the Source Location

If the (recommended) partial reflection option is used, RTDM must be informed of terrain heights and their downwind distances from the source locations in each of 36 directions, 10° apart. RTDM chooses the nearest multiple of 10° each hour from the wind direction data to estimate the terrain profile experienced by the plume. The terrain heights are obtained from a topographic map, as shown in Figure 2-3 and as tabulated in Figure 2-4.

The procedure used to select receptor heights should be consistent with that for obtaining terrain profiles. If, for example, the highest terrain along a 10° arc is used for specifying terrain heights for rings of 36 receptors each, then the same procedure (maximum on an arc) should be used to specify terrain profiles.

The recommended procedure for obtaining the terrain information is as follows:

1) Start at a convenient elevation contour that is at or below the lowest stack top, so that no plume impacts will occur at or below this elevation.

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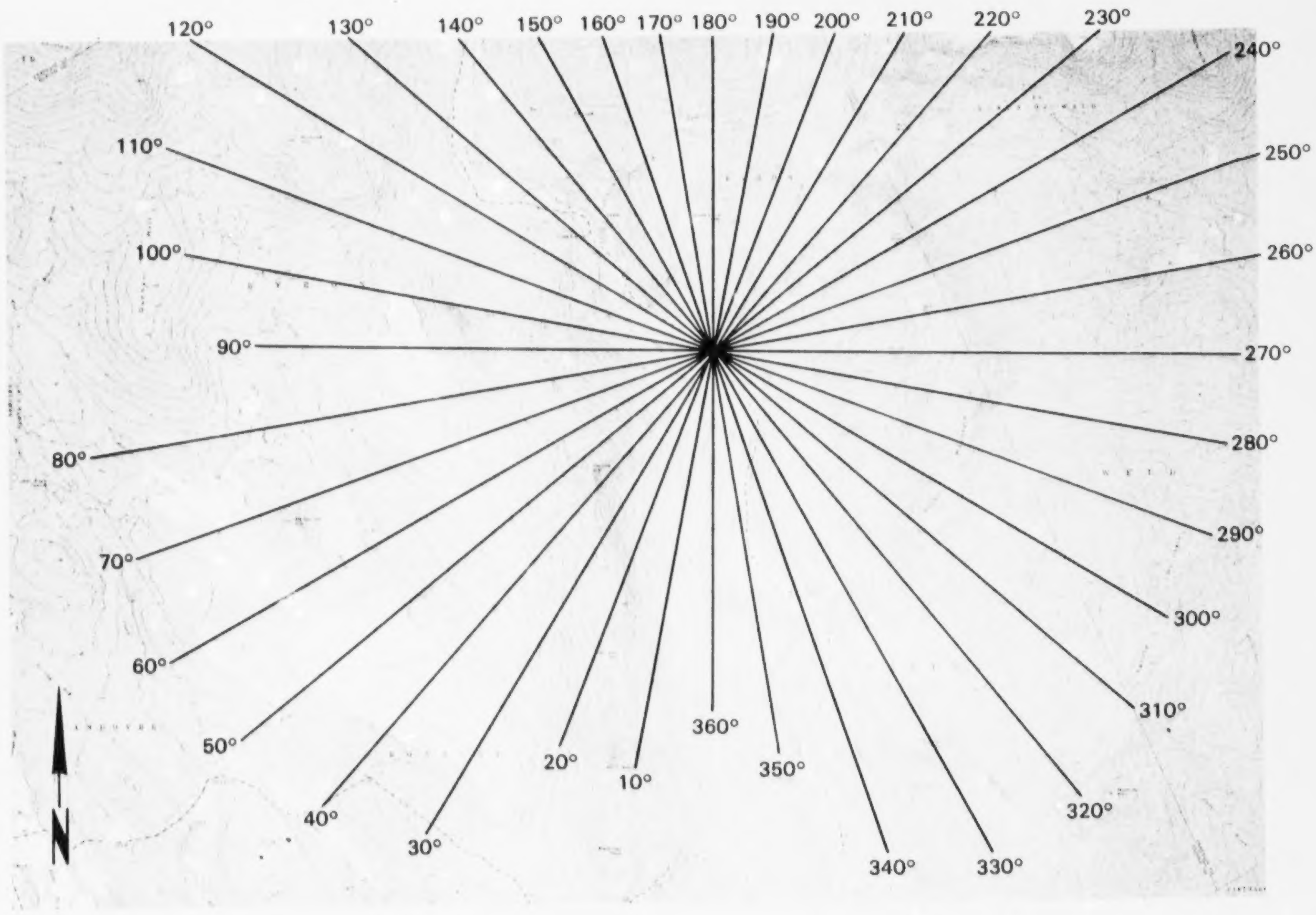

120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
360°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
N

Figure 2-3 Terrain is Defined at 10° Intervals Surrounding the Source Location

```
ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                              PAGE   4

       TERRAIN INFORMATION:          .

                TABLE OF DISTANCES (KM) FROM THE SOURCE TO ELEVATION CONTOURS AS A FUNCTION OF WIND DIRECTION

                                                                 ELEVATION IN USER UNITS:
WIND DIR.   1100.  1200.  1300.  1400.  1500.  1600.  1700.  1800.  1900.  2000.  2100.  2200.  2300.  2400.  2500.  2600.  2700.  2800.  2900.  3000.

   10       4.46   4.70   5.01   7.00   7.30
   20       1.50   3.35   3.45   3.75   3.85   3.95   4.05   4.20   4.60   4.70   4.80
   30       1.40   1.50   1.65   3.00   3.10   3.16   3.24   3.31   3.50
   40       1.28   1.40   1.46   1.53   1.61   1.74   1.88   1.98   2.72
   50       1.15   1.30   1.39   1.49   1.60   1.69   1.75   1.82   1.94   2.06   2.13   2.22   2.34
   60       1.18   1.29   1.40   1.48   1.58   1.69   1.80   1.94   2.10   2.24   2.58
   70       1.25   1.47   1.60   1.72   1.87   2.03   2.20   2.32   2.47
   80       1.41   1.58   1.70   1.87   2.00   2.12   2.24   2.38   2.44   2.49   2.59
   90       1.64   1.75   1.88   1.99   2.09   2.20   2.39   2.59   2.76   2.94   3.08
  100       1.99   2.09   2.18   2.30   2.52   2.59   2.66   2.71   2.81   2.95   3.09   3.18   3.29
  110       2.02   2.28   2.40   2.52   2.63   2.72   3.00   3.19   3.55
  120       2.21   2.41   2.52   2.63   5.75   5.90   6.01   6.18   6.30   6.50   6.73   6.85   7.07
  130       2.75   5.47   5.62   5.92   6.01   6.70   6.90   7.37   7.48   7.79
  140       1.22   1.29   6.70   6.80   6.90   7.00
  150       1.11   1.19   1.24   1.29   1.32
  160       1.08   1.15   1.21   1.28   1.38   1.42   5.13   5.32   5.51
  170       1.01   1.12   1.23   1.34   1.48   1.53   4.98
  180        .81   1.04   1.18   1.38   1.51   1.66   1.82   2.10   2.23   2.31   4.79   4.92   5.05
  190        .79    .90   1.07   1.23   1.37   1.50   1.71   1.81   1.91   2.01
  200        .68    .82   1.00   1.16   1.30   1.50   1.68   1.95   2.52
  210        .71    .83   1.03   1.20   1.43   1.58   1.81   2.15   2.30   2.52   2.62   2.73
  220        .82    .99   1.25   1.32   1.49   1.70   2.04   2.22   2.50   2.86   5.58   5.75   6.05   6.11   6.16   6.19   6.21   6.23   6.27   6.29
  230       1.05   1.21   1.48   1.61   2.02   2.17   2.28   2.42   2.54   2.67   2.84   3.01   3.17   3.21   3.28   3.32   7.42   7.49
  240       1.05   1.20   1.41   1.61   1.78   1.90   2.04   2.16   2.38   2.52   2.68   2.80   2.91   3.14   3.31   3.39   3.45
  250       1.00   1.23   1.31   1.40   1.56   1.70   1.86   1.97   2.08   2.17   2.30   2.45   2.57   2.80
  260       1.00   1.11   1.27   1.36   1.49   1.60   1.78   2.09   2.27   2.45   2.56   2.63   2.73   2.84
  270       1.03   1.16   1.28   1.38   1.48   1.53   1.66   1.73   1.88   2.09   2.26   2.49   2.61
  280       1.09   1.22   1.34   1.43   1.54   1.63   1.71   1.76   1.82   1.89   1.97   2.10   3.50   3.58   3.70
  290       1.16   1.28   1.43   1.57   1.67   1.76   1.83   1.98   2.13   3.26   3.34   3.50   3.65   3.79   3.90   4.05
  300       1.28   1.41   1.60   1.74   1.89   2.10   2.90   3.01   3.16   3.24   3.33   3.96   4.03   4.17
  310       1.46   1.60   1.75   1.90   2.90   3.04   3.42   3.59   3.75   3.90   3.98   4.08   4.20   8.25   8.35
  320       1.65   1.85   2.00   3.12   3.36   3.49   4.05   4.20   4.42   8.55   8.65
  330       2.18   2.97   4.42   4.61   4.78
  340       6.23   6.42   6.58
  350       4.69   4.90
  360       4.31   6.80
```

Figure 2-4 RTDM Tabulation of Terrain Information in 36 Directions Surrounding the Source Location

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2) Determine the "hill top" elevation for each 10° radial. In general, the highest terrain along the radial on the specific local hill (or hills) where concentrations are to be predicted in each direction should be used. If some receptors lie on a hill or hills in the lee of the closest hill to the source, separate model runs are recommended for receptors on the more distant hills if these lee hills are higher than the first in elevation. This strategy assigns the proper hill height to receptors on the first hill if the first hill is run separately from higher hills behind it. If a lee hill is shorter than the first hill, then the top of the first hill should be used to define the "hill top" elevation for both hills.

   The user should keep in mind that RTDM has not been designed or extensively tested for predicting concentrations in the lee of hills closest to the source of interest. The consideration of large downwind distances may involve a series of terrain obstacles in a given direction. Flow structures on the lee side of terrain obstacles are often more complicated than that on the windward side.

3) Determine a convenient contour increment between the lowest and highest elevations (obtained from steps 1 and 2) such that 19 or fewer increments span the interval between lowest and highest elevations.

   Example (see Figures 2-3, 2-4):

   Stack-top elevation is 1165 feet, so choose 1100 feet as the first contour. Highest contour of interest in any direction is 3,000 feet. Choose 100 feet as the contour increment.

4) Along each of 36 directions about the source location (in even multiples of 10 degrees), tabulate the downwind distances in kilometers to each contour level to be considered. In each direction, stop at the hill top, determined as discussed above (see Figure 2-4). If the terrain does not steadily increase away from the source in a

given direction, then tabulate the closest distance of a given contour level, and ignore successive occurrences of that same level, searching instead for the closest distance to the next highest contour of interest.

5) RTDM will print a crude map (see Figure 2-5) of the terrain that the user specifies, and will also denote the location of any model receptors on the map. Check this map to verify that the representation of terrain in the model is correct. On the RTDM map, codes for some contours may be overwritten in very steep terrain locations where two contours would occupy the same printing position.

6) IMPORTANT NOTE: It is necessary to specify terrain beyond actual receptor locations until the hill top is reached so that the hill height is accurately known. Terrain need not be specified where no receptors exist. However, off-centerline or sector averaging calculations require terrain input for sectors adjacent to those where receptors are located as well as those occupied by receptors.

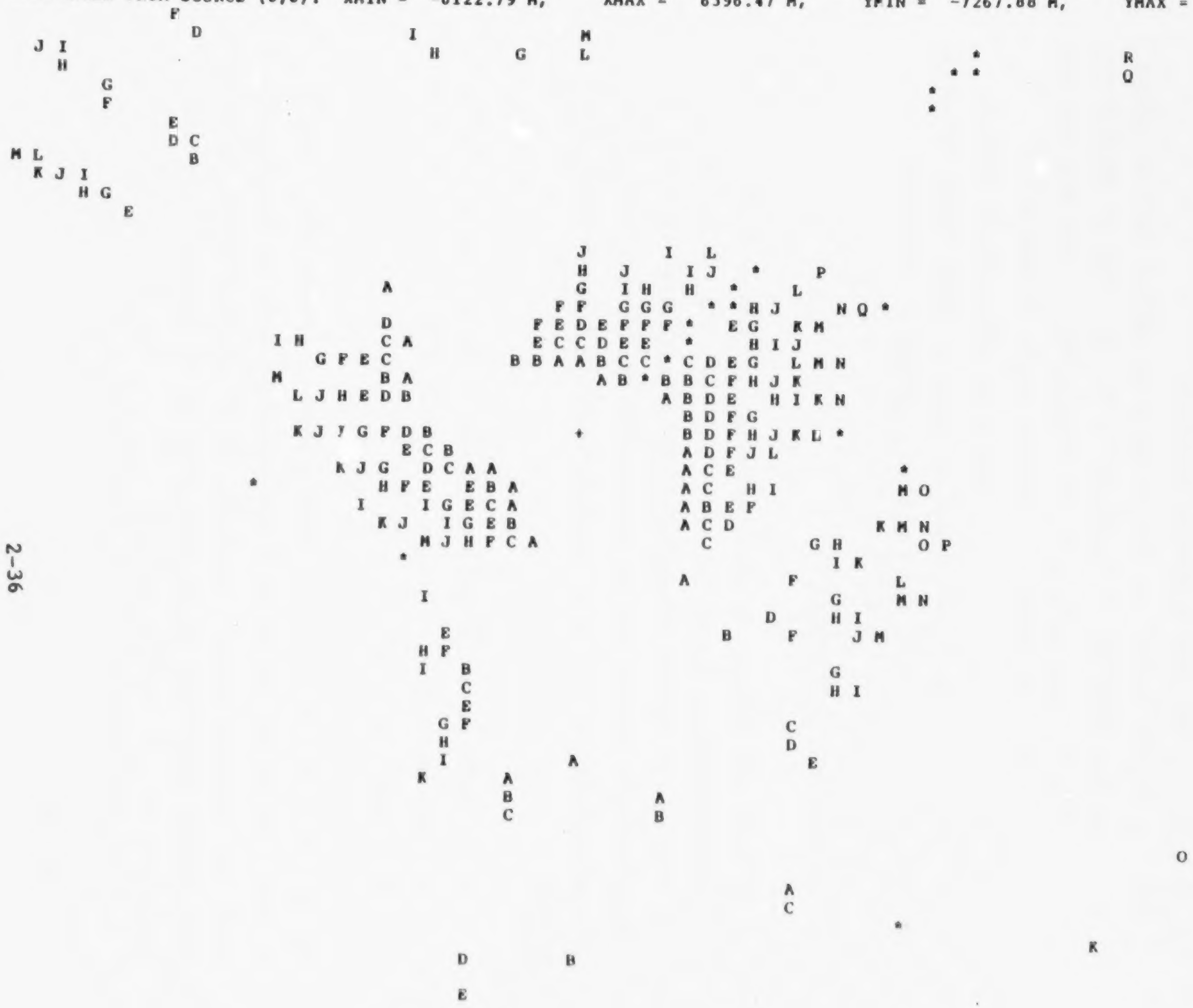
2.15 Multiple-Hour Averages

In both the case-study and the sequential modes, RTDM produces hourly concentration values for each hour included in the input data set. Concentrations for averaging times greater than one hour are computed by the postprocessing program ANALYSIS (see Section 6). This program uses the disk file of concentrations written by RTDM and can create

1) n-hour non-overlapping averages (n from 1 to 24)
2) n-hour running averages (n from 1 to 24)
3) annual averages

as well as detailed output concerning peak concentrations. The current version of the ANALYSIS postprocessor does not handle calm winds in a special manner. However, use of on-site wind data rather than airport wind data causes calm winds to be quite rare in most cases.

```
MAP OF USER-SPECIFIED TERRAIN:  LETTERS (SOME OVERWRITTEN) DENOTE ELEVATIONS (SEE TABLE); "+" = SOURCE; "*" = A RECEPTOR POINT
   DISTANCES FROM SOURCE (0,0):  XMIN =  -6122.79 M,     XMAX =   6396.47 M,     YMIN =  -7267.88 M,     YMAX =   5362.32 M
```



```
CONTOUR
CODES

A  1100.00
B  1200.00
C  1300.00
D  1400.00
E  1500.00
F  1600.00
G  1700.00
H  1800.00
I  1900.00
J  2000.00
K  2100.00
L  2200.00
M  2300.00
N  2400.00
O  2500.00
P  2600.00
Q  2700.00
R  2800.00
S  2900.00
T  3000.00
```

Figure 2-5 RTDM Crude Map of Terrain and Receptor Locations Based Upon User Input

In summary, the ANALYSIS output may include:

1) The X highest average concentrations at each receptor together with day and hour of occurrence for n-hour (non-overlapping) averages.
2) The cumulative frequency distribution of n-hour (non-overlapping) average concentrations at each receptor (n can be as high as 24). Annual average concentration values are also given.
3) Tabulation for each receptor of all n-hour (non-overlapping) averages which exceed a specified concentration threshold. The summary output includes a table by receptor of maximum n-hour average concentrations.
4) The production of sequential concentrations of running averages from an input concentration sequence. This sequence can be processed to provide any of the statistics described in 1-3 above for running averages.
5) The production of sequential concentrations that result from adding concentrations from 2 to 5 separate files (source groups). These concentrations may be multiplied by a scale factor before summing.

3. MODEL INPUT DATA

3.1 Meteorological Data

RTDM reads a text file of meteorological data with each line in the file representing one hour. Each line begins with year, Julian day, and hour information. Any number of hours may be run, but RTDM checks each line for chronological sequence. If the hourly sequence is broken, a non-fatal warning message is printed.

The format of each line in the meteorological input file is described in Table 3-1. Wind direction, wind speed, mixing height, stability class, and ambient temperature values must be specified for each hour. The other variables are optional and their inclusion depends upon the availability of the on-site data involved and the decision of the RTDM user concerning what model parameters to use. Missing values should be specified as -999. in the input file. If a missing value is encountered, the last non-missing value for that parameter is used. Initial persistence values are specified by the user in case the first hour is missing for a parameter. The initial values are designed to be used to specify a constant value of any parameter for the entire RTDM run (with all hourly values set to -999.). It is recommended that the user replace missing data with alternate values to prevent persistence of meteorological quantities that normally change frequently throughout the day. An example of an RTDM meteorological input file is shown in Figure 3-1.

3.2 Emissions Data

Hourly emissions data need not be supplied by the RTDM user if constant stack emissions are to be modeled. The constant emissions values are specified in the STACKS section of the RTDM input run stream. If hourly emissions values are to be used, they must be input for all stacks. However, since the initialized values are the constant emissions values specified in the STACKS section, use of -999. (missing) values for all hours for a stack reverts to constant emissions for that stack.

TABLE 3-1

FORMAT* OF RTDM HOURLY METEOROLOGICAL INPUT

Parameter	Columns	Comments
Year	1-2	Last 2 digits (1982=82)
Julian Day	3-5	1-366
Hour	6-7	Time at end of hour (01-24)
Wind Direction	9-14	In degrees, direction from which wind is blowing
Wind Speed (#1)	15-20	Units converted to m/sec with USCALE
Mixing Height	21-26	In meters
Stability Class	27-32	Turner (1964) method recommended
Ambient Temperature	33-38	Degrees Fahrenheit
Turbulence Intensity, y-component	39-44	Convert σ_θ to radians, or use I_y directly
Turbulence Intensity, z-component	45-50	Convert σ_ϕ to radians , or use I_z directly
VPTG, plume rise	51-56	Use data near stack-top location and elevation, °C/m
VPTG, H_{crit}	57-62	Use data near terrain obstacle of interest, °C/m
Horizontal wind shear	63-68	Use data as close to typical plume height as possible, degrees/meter
Wind Speed Profile exponent	69-74	See subsection 2.4
Alternate Wind Speed	75-80	Used for plume dilution, if available (in user units)

---

*Year, Julian Day, Hour are in fixed point format; other variable are in floating point format

```
7636524 220.  1.0   3000. 1.   68.   0.22  0.20  0.0   0.0   0.1   0.07  2.0
7636601 220.  1.5   3000. 1.   68.   0.22  0.20  0.0   0.0   0.1   0.07  3.0
7636602 220.  2.0   3000. 1.   68.   0.22  0.20  0.0   0.0   0.1   0.07  4.0
7636603 220.  2.5   3000. 1.   68.   0.22  0.20  0.0   0.0   0.1   0.07  5.0
7636604 220.  3.0   3000. 1.   68.   0.22  0.20  0.0   0.0   0.1   0.07  6.0
7636607 220.  1.0   3000. 2.   68.   0.16  0.12  0.0   0.0   0.12  0.09  2.0
7636608 220.  1.5   3000. 2.   68.   0.16  0.12  0.0   0.0   0.12  0.09  3.0
7636609 220.  2.0   3000. 2.   68.   0.16  0.12  0.0   0.0   0.12  0.09  4.0
7636610 220.  2.5   3000. 2.   68.   0.16  0.12  0.0   0.0   0.12  0.09  5.0
7636611 220.  3.0   3000. 2.   68.   0.16  0.12  0.0   0.0   0.12  0.09  6.0
7636612 220.  4.0   3000. 2.   68.   0.16  0.12  0.0   0.0   0.12  0.09  7.0
7636613 220.  5.0   3000. 2.   68.   0.16  0.12  0.0   0.0   0.12  0.09  8.5
7636614 220.  2.0   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  4.0
7636615 220.  2.5   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  5.0
7636616 220.  3.0   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  6.0
7636617 220.  4.0   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  8.0
7636618 220.  5.0   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  10.0
7636619 220.  7.0   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  14.0
7636620 220.  10.   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  18.0
7636621 220.  12.   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  21.0
7636622 220.  15.   3000. 3.   68.   0.11  0.08  0.0   0.0   0.15  0.12  25.0
7700101 220.  1.0   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  2.0
7700102 220.  1.5   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  3.0
7700103 220.  2.0   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  4.0
7700104 220.  2.5   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  5.0
7700105 220.  3.0   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  6.0
7700106 220.  4.0   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  8.0
7700107 220.  5.0   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  10.0
7700108 220.  7.0   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  14.0
7700109 220.  10.   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  20.0
7700110 220.  12.   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  24.0
7700111 220.  15.   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  30.0
7700112 220.  20.   3000. 4.   68.   0.08  0.06  0.0   0.0   0.20  0.14  35.0
7700113 220.  2.0   3000. 5.   68.   0.06  0.03  0.02  0.02  0.30  0.25  5.0
7700114 220.  2.5   3000. 5.   68.   0.06  0.03  0.006 0.02  0.30  0.25  7.0
7700115 220.  3.0   3000. 5.   68.   0.06  0.03  0.001 0.001 0.30  0.25  9.0
7700116 220.  4.0   3000. 5.   68.   0.06  0.03  0.0   0.0   0.30  0.25  10.0
7700117 220.  5.0   3000. 5.   68.   0.06  0.03  0.04  0.006 0.30  0.25  12.0
7700118 220.  2.0   3000. 6.   68.   0.04  0.016 0.035 0.035 0.40  0.35  5.0
7700119 220.  2.5   3000. 6.   68.   0.04  0.016 0.006 0.02  0.40  0.35  7.0
7700120 220.  3.0   3000. 6.   68.   0.04  0.016 0.001 0.001 0.40  0.35  9.0
7700121 220.  4.0   3000. 6.   68.   0.04  0.016 0.0   0.0   0.40  0.35  10.0
7700122 220.  5.0   3000. 6.   68.   0.04  0.016 0.04  0.006 0.40  0.35  12.0
```

Figure 3-1   Sample RTDM Hourly Meteorological Input File

The format of each line in the emissions input file is described in Table 3-2. Values of emissions, exit velocity, and stack gas temperature must be supplied each hour. If a value is missing, the previous good value is used. If the first hour is missing, the constant value specified in the STACKS section is used.

One line per stack must be supplied each hour, in the order that the stacks are listed in the STACKS section. The times specified by the meteorological and emissions input files must agree, or RTDM signals a fatal runtime error. An example of an RTDM hourly emissions file is shown in Figure 3-2.

TABLE 3-2

FORMAT* OF RTDM HOURLY EMISSIONS INPUT**

Parameter	Columns	Comments
Year	1-2	Last 2 digits (1982=82)
Julian Day	3-5	1-366
Hour	6-7	Time at end of hour (01-24)
Emission rate of pollutant	11-20	g/sec
Stack gas exit velocity	21-30	m/sec
Stack gas temperature	31-40	°K

---

*Year, Julian Day, Hour in fixed point format; other variables in floating point format.

**One line per stack for each hour, in the order listed in the STACKS section.

```
7636522    1000.     20.        370.
7636522    1500.     18.        380.
7636523    2000.     20.        370.
7636523    1500.     18.        380.
7636524    1000.     20.        370.
7636524    3000.     18.        380.
7636601    1000.     10.        370.
7636601    1500.     10.        380.
7636602    1000.     10.        370.
7636602    1500.     10.        380.
7636603    1000.     20.        420.
7636603    1500.     18.        420.
7636604    2000.     20.        370.
7636604    3000.     18.        380.
7636605    2000.     20.        370.
7636605    3000.     18.        380.
7636606    2000.     20.        370.
7636606    3000.     18.        380.
7636607    2000.     20.        370.
7636607    3000.     18.        380.
7636608    2000.     20.        370.
7636608    3000.     18.        380.
7636609    2000.     20.        370.
7636609    3000.     18.        380.
7636610    2000.     20.        370.
7636610    3000.     18.        380.
7636611    2000.     20.        370.
7636611    3000.     18.        380.
7636612    2000.     20.        370.
7636612    3000.     18.        380.
7636613    2000.     20.        370.
7636613    3000.     18.        380.
7636614    2000.     20.        370.
7636614    3000.     18.        380.
7636615    2000.     20.        370.
7636615    3000.     18.        380.
7636616    2000.     20.        370.
7636616    3000.     18.        380.
7636617    2000.     20.        370.
7636617    3000.     18.        380.
7636618    2000.     20.        370.
7636618    3000.     18.        380.
7636619    2000.     20.        370.
7636619    3000.     18.        380.
7636620    2000.     20.        370.
7636620    3000.     18.        380.
7636621    2000.     20.        370.
7636621    3000.     18.        380.
7636622    2000.     20.        370.
7636622    3000.     18.        380.
```

Figure 3-2   Sample RTDM Hourly Emissions File for Two Stacks

```
7636623   2000.    20.    370.
7636623   3000.    18.    380.
7636624   2000.    20.    370.
7636624   3000.    18.    380.
7700101   1000.    10.    370.
7700101   1500.    10.    380.
7700102   1000.    10.    370.
7700102   1500.    10.    380.
7700103   1000.    20.    420.
7700103   1500.    18.    420.
7700104   2000.    20.    370.
7700104   3000.    18.    380.
7700105   2000.    20.    370.
7700105   3000.    18.    380.
7700106   2000.    20.    370.
7700106   3000.    18.    380.
7700107   2000.    20.    370.
7700107   3000.    18.    380.
7700108   2000.    20.    370.
7700108   3000.    18.    380.
7700109   2000.    20.    370.
7700109   3000.    18.    380.
7700110   2000.    20.    370.
7700110   3000.    18.    380.
7700111   2000.    20.    370.
7700111   3000.    18.    380.
7700112   2000.    20.    370.
7700112   3000.    18.    380.
7700113   2000.    20.    370.
7700113   3000.    18.    380.
7700114   2000.    20.    370.
7700114   3000.    18.    380.
7700115   2000.    20.    370.
7700115   3000.    18.    380.
7700116   2000.    20.    370.
7700116   3000.    18.    380.
7700117   2000.    20.    370.
7700117   3000.    18.    380.
7700118   2000.    20.    370.
7700118   3000.    18.    380.
7700119   2000.    20.    370.
7700119   3000.    18.    380.
7700120   2000.    20.    370.
7700120   3000.    18.    380.
7700121   2000.    20.    370.
7700121   3000.    18.    380.
7700122   2000.    20.    370.
7700122   3000.    18.    380.
```

Figure 3-2 (Continued)

4. USE OF PREPRO - A METEOROLOGICAL PREPROCESSOR

4.1 Input Requirements

Two input files are required:

FILE 1 - This is a binary meteorological file from the EPA preprocessor RAMMET. This binary file has a header which indicates the station and year for surface and upper air data. This header is skipped when input into PREPRO, and the subsequent data are read in the following sequence:

- Year
- Month
- Day
- Stability Class each hour (24)
- Wind Speed each hour (24)
- Temperature each hour (24)
- Wind direction each hour - not randomized (24)
- Wind direction each hour - randomized (24)
- Mixing height each hour:
    - Rural (24)
    - Urban (24)

FILE 2 - This is a 1-line user assembled text file containing the following:

Columns 1-5:	The number of days in FILE 1 to skip before processing
Columns 1-10:	The number of days in FILE 1 to process into RTDM input format

4.2 Output Description

The output file is in the format described for the RTDM meteorological input file (see subsection 3.1). Rural mixing heights, rather than urban values, are used. Each day of the data in FILE 1 is converted into 24 lines in the output file. The resulting output file has the minimum number of input parameters necessary for running RTDM; no optional values are supplied.

4.3 Computer Job Control Considerations

The input data is a binary meteorological data file which has been processed by RAMMET. This input data is read in by PREPRO from unit 2. The one-line user-assembled text file is read from unit 1. The output file is written to unit 3.

On computers with disk file name assignments in the FORTRAN "OPEN" commands, suggested file names associated with units 1, 2, and 3 are "PREPRO.IN", "@DATA", and "@LIST", respectively.

5. USE OF RTDM

5.1 Input Run Stream

The RTDM input run stream consists of several distinct sections, in the following order of keywords:

PARAMETERS
STACKS
POINTS
TERRAIN
EXECUTE

Each of these sections encompasses one group of input data necessary to define an RTDM run, and is identified by listing the section name (i.e. PARAMETERS, STACKS, etc.) as the first line of the section. These section names are referred to as keywords. Each section is concluded with a line containing only '99999' in columns 1-5.

Of the keywords, PARAMETERS must be specified first followed by STACKS, POINTS, TERRAIN and EXECUTE, in that order. Table 5-1 contains a keyword summary. A sample input stream is shown in Figure 5-1.

5.1.1 PARAMETERS Keyword

The PARAMETERS keyword marks the beginning of that portion of the input stream which serves to override the default options and specify specific program options to be used.

There are 25 parameter groups which may be specified by the user. A parameter group need be included in the parameter package only if the default value is not the one that the user wishes to select. The 25 parameter groups are listed in Table 5-2.

TABLE 5-1

SUMMARY OF KEYWORDS USED IN AN RTDM INPUT STREAM

PARAMETERS	This keyword is used to override default values of model constants and control parameters.
STACKS	This keyword is used to describe the locations and fixed physical characteristics of the point sources.
POINTS	This keyword is used to describe receptor locations.
TERRAIN	This keyword is used to input terrain height information and distances of height contours from the source location. If the partial reflection option is not used, this keyword is still needed to define hill height values for computation of H_{crit}.
EXECUTE	This keyword terminates the reading of the input run stream and initiates program execution.

```
PARAMETERS
PR003    1.
PR004    10.0                  0.       0.
PR022    1.
PR018    1.
PR019    1.
PR020    1.       .17
PR021    1.
PR023    1.
         22.5     22.5     22.5     22.5     22.5     22.5
PR025    1.
99999
STACKS
600.        800.        765.        SO2
STK1        121.92      5.0         20.0        370.        1000.
99999
POINTS
            603.16      801.61      2782.       WEST MT.
            602.75      799.90      2430.       BRUSH MT.
            603.46      799.41      2520.       WALKER MT.
            600.53      800.63      1100.
            600.64      800.76      1200.
            600.80      800.96      1300.
            600.85      801.01      1400.
            600.96      801.14      1500.
            601.09      801.30      1600.
            601.31      801.56      1700.
            601.43      801.70      1800.
            601.61      801.92      1900.
            601.84      802.19      2000.
            603.59      804.27      2100.
            603.70      804.40      2200.
            603.89      804.63      2300.
            603.93      804.68      2400.
            603.96      804.72      2500.
            603.98      804.74      2600.
            603.99      804.76      2700.
            604.00      804.77      2800.
            604.03      804.80      2900.
            604.04      804.82      3000.       TUMBLEDOWN MT.
            603.35      793.70      1631.       BUNKER MT.
            598.10      798.23      2440.       RECORD HILL
            596.53      799.26      2440.       OLD TURK MT.
99999
TERRAIN
1100.       100.
010         4.46     4.78     5.01     7.00     7.38     -999.

020         1.50     3.35     3.45     3.75     3.85     3.95     4.05     4.20     4.60     4.70
            4.80     -999.
030         1.40     1.50     1.65     3.00     3.10     3.16     3.24     3.31     3.50     -999.

040         1.28     1.40     1.46     1.53     1.61     1.74     1.88     1.98     2.72     -999.

050         1.15     1.30     1.39     1.49     1.60     1.69     1.75     1.82     1.94     2.06
            2.13     2.22     2.[illegible]4     -999.
060         1.18     1.29     1.40     1.48     1.58     1.69     1.80     1.94     2.10     2.24
```

Figure 5-1

```
          2.58    -999.
070       1.25    1.47    1.60    1.72    1.87    2.03    2.20    2.32    2.47    -999.

080       1.41    1.58    1.70    1.87    2.00    2.12    2.24    2.38    2.44    2.49
          2.59    -999.
090       1.64    1.75    1.88    1.99    2.09    2.20    2.39    2.59    2.76    2.94
          3.08    -999.
100       1.99    2.09    2.18    2.30    2.52    2.59    2.66    2.71    2.81    2.95
          3.09    3.18    3.29    -999.
110       2.02    2.28    2.40    2.52    2.63    2.72    3.00    3.19    3.55    -999.

120       2.21    2.41    2.52    2.63    5.75    5.90    6.01    6.18    6.30    6.50
          6.73    6.85    7.07    -999.
130       2.75    5.47    5.62    5.92    6.01    6.70    6.90    7.37    7.48    7.79
          -999.
140       1.22    1.29    6.70    6.80    6.90    7.00    -999.

150       1.11    1.19    1.24    1.29    1.32    -999.

160       1.08    1.15    1.21    1.28    1.38    1.42    5.13    5.32    5.51    -999.

170       1.01    1.12    1.23    1.34    1.48    1.53    4.98    -999.

180       0.81    1.04    1.18    1.38    1.51    1.66    1.82    2.10    2.23    2.31
          4.79    4.92    5.05    -999.
190       0.79    0.90    1.07    1.23    1.37    1.50    1.71    1.81    1.91    2.01
          -999.
200       0.68    0.82    1.00    1.16    1.30    1.50    1.68    1.95    2.52    -999.

210       0.71    0.83    1.03    1.20    1.43    1.58    1.81    2.15    2.30    2.52
          2.62    2.73    -999.
220       0.82    0.99    1.25    1.32    1.49    1.70    2.04    2.22    2.50    2.86
          5.58    5.75    6.05    6.11    6.16    6.19    6.21    6.23    6.27    6.29
230       1.05    1.21    1.48    1.61    2.02    2.17    2.28    2.42    2.54    2.67
          2.84    3.01    3.17    3.21    3.28    3.32    7.42    7.49    -999.
240       1.05    1.20    1.41    1.61    1.78    1.90    2.04    2.16    2.38    2.52
          2.68    2.80    2.91    3.14    3.31    3.39    3.45    -999.
250       1.00    1.23    1.31    1.40    1.56    1.70    1.86    1.97    2.08    2.17
          2.30    2.45    2.57    2.80    -999.
260       1.00    1.11    1.27    1.36    1.49    1.60    1.78    2.09    2.27    2.45
          2.56    2.63    2.73    2.84    -999.
270       1.03    1.16    1.28    1.38    1.48    1.53    1.66    1.73    1.88    2.09
          2.26    2.49    2.61    -999.
280       1.09    1.22    1.34    1.43    1.54    1.63    1.71    1.76    1.82    1.89
          1.97    2.10    3.50    3.58    3.70    -999.
290       1.16    1.28    1.43    1.57    1.67    1.76    1.83    1.98    2.13    3.26
          3.34    3.50    3.65    3.79    3.90    4.05    -999.
300       1.28    1.41    1.60    1.74    1.89    2.10    2.90    3.01    3.16    3.24
          3.33    3.96    4.03    4.17    -999.
310       1.46    1.60    1.75    1.90    2.90    3.04    3.42    3.59    3.75    3.90
          3.98    4.08    4.20    8.25    8.35    -999.
320       1.65    1.85    2.00    3.12    3.36    3.49    4.05    4.20    4.42    8.55
          8.65    -999.
330       2.18    2.97    4.42    4.61    4.78    -999.

340       6.23    6.42    6.58    -999.
```

Figure 5-1 (cont.)

```
350       4.69   4.90   -999.

360       4.31   6.80   -999.

99999
EXECUTE
        220.  5.0   3000. 4.    68.   0.08  0.06  0.0   0.0   0.20  0.14 10.
ENDJOB
```

Figure 5-1 (cont.)

TABLE 5-2

LIST OF PARAMETER GROUPS INCLUDED IN RTDM

Parameter Group No.	Parameter Group Description
1	Horizontal scale (# of meters per user unit)
2	Vertical scale (# of meters per user unit)
3	Wind speed scale (# of m/sec per user unit)
4	Anemometer heights for wind speed #1 (mandatory), wind speed #2 (optional), and a switch determining the wind speed used for plume dilution, and the height of the origin of the wind speed profile
5	Default, stability-dependent wind speed profile exponents
6	Switch determining type of stability-dependent dispersion coefficients used (P-G, ASME or user-supplied)
7	User-supplied y-component dispersion coefficients
8	User-supplied z-component dispersion coefficients
9	Switch for use of partial plume penetration option, and VPTG value to be used for the strength of the elevated inversion
10	Switch for use of buoyancy-enhanced dispersion, plus value α used for determining its magnitude: $\Delta H/\alpha$
11	Switch for specifying unlimited mixing height for stable conditions
12	Switch for use of transitional plume rise
13	Stability-dependent values of plume path correction factor
14	Default, stability-dependent values of VPTG, applies to stable conditions only

TABLE 5-2 (Continued)

Parameter Group No.	Parameter Group Description
15	Switch for use of stack-tip downwash
16	Switch for use of hourly I_y values
17	Switch for use of hourly I_z values
18	Switch for use of hourly VPTG values for computing stable plume rise
19	Switch for use of hourly VPTG values for computing H_{crit}
20	Switch for use of horizontal wind shear to improve calculations of $_y$; specification of coefficient for that calculation
21	Switch for use of hourly wind speed profile exponent values
22	Switch for use of partial reflection factor
23	Switch for determination of the type of horizontal averaging (sector averaged or off-centerline); specification of stability-dependent sector widths
24	Switch for use of hourly emissions data
25	Switch for case-study printout

PARAMETERS Input Format

First Line - The keyword PARAMETERS, is placed in columns 1 to 10.

Successive Lines - The standard format has up to six data fields on each line. The first line in each parameter group contains the group name in the first five (5) columns. All group names are of the form PRnnn, where nnn is a group number, from 001 to 025. Unless otherwise noted, the parameter values are held in six fields per line, floating point format, beginning in column 9. Parameter groups may be input in any order.

The general format for a PARAMETERS input line is:

Columns	Variable	Format	Meaning
1-5	PGNAM	A2, I3	Parameter group names, 'PRNNN' for the first card of the group. Blank for following cards.
9-16	VAR1	E8.0	First parameter value
17-24	VAR2	E8.0	Second parameter value
25-32	VAR3	E8.0	Third parameter value
33-40	VAR4	E8.0	Fourth parameter value
41-48	VAR5	E8.0	Fifth parameter value
49-56	VAR6	E8.0	Sixth parameter value

Input among parameter groups will differ in format, in general. Any parameter group to be specified will require at least one line, and more if there are more than six values to be specified. If a parameter group contains less than seven values, then only one line is needed to characterize the new values. This is true for all except the following parameters: PR007, PR008, PR023.

If a parameter group contains more than six values, then more than one line will be necessary to specify the group. This situation exists with parameters PR007, PR008 (10 lines each) and PR023 (2 lines).

Parameter groups may not be partially input; if some data lines from a group are omitted, results are unpredictable.

Table 5-3 contains a detailed description of the input format for all parameter groups, as well as the default values for all variables. Recommended choices for parameters for general use of RTDM in a screening mode are described in Table 5-4.

Last Line

The PARAMETERS section is terminated by a standard 99999 delimiter. The 99999 must be placed in columns 1-5.

A sample PARAMETERS section is shown as part of Figure 5-1.

5.1.2 STACKS Keyword

The STACKS section is used to describe the dimensions and emission characteristics of each input source. This keyword also specifies the identity of the pollutant being considered in the model run. Data required for the STACKS keyword include:

For all stacks:

1) the name of the pollutant whose dispersion is being simulated (e.g. SO_2, TSP).
2) the stack coordinates x, y (all must be co-located with a common stack base elevation).
3) the stack base elevation in user units
4) the stack height (m)
5) the stack diameter (m)

TABLE 5-3

FORMATS AND DEFAULT VALUES OF VARIABLES USED IN PARAMETERS

Name	Variable	Dimension	Default	Format	Description
PR001	HSCALE	1	1000.	(A2,I3,3X,E8.0)	Scale factor to convert user horizontal units to meters. Default converts km to m.
PR002	VSCALE	1	0.3048	(A2,I3,3X,E8.0)	Scale factor to convert user vertical units to meters. Default converts feet to meters.
PR003	USCALE	1	0.4471	(A2,I3,3X,E8.0)	Scale factor to convert user wind speed units to m/sec. Default converts mph to m/sec.
PR004	ZWIND1, ZWIND2, IDILUT ZA	1 1 1 1	10. 10. 0 0	(A2,I3,3X,4E8.0)	Anemometer height for mandatory wind speed (#1), and meter height for optional wind speed (#2), dilution switch (0 = use wind speed #1 at stack top height, 1 = use wind speed #1 at plume height, 2 = use wind speed #2 at plume height) height above stack base elevation (m) where wind profile is assumed to originate
PR005	EXPOW	6	.09, .11, .12, .14, .20, .30	(A2,I3,3X,6E8.0)	Default, stability-dependent wind speed profile exponents.
PR006	ICOEF	1	3	(A2,I3,3X,E8.0)	Switch for specifying type of stability-dependent dispersion parameters (1 = user-specified, 2 = P-G, 3 = ASME, 1979)
PR007	XY1,XY2,	1,1	best fit to ASME, 1979	line 1:(A2,I3, 3X,2E8.0)	XY1,XY2 are crossover distances (m) for σ_y, such that (for stability class i): 1) for x < XY1, σ_y = AY(i,1)*BY(i,1)**CY(i,1) 2) for XY1 < x ≤ XY2, σ_y = AY(i,2)*BY(i,2)**CY(i,2) 3) for XY2 < x, σ_y = AY(i,3)*BY(i,3)**CY(i,3)
	AY,BY,CY	(6,3),(6,3) (6,3)		lines 2-10: (8X, 6E8.0)	
PR008	XZ1, XZ2	1,1	best fit to ASME, 1979	line 1: (A2,I3 3X,2E8.0)	XZ1, XZ2 are crossover distances (m) for σ_z, such that (for stability class i): 1) for x ≤ XZ1, σ_z = AZ(i,1)*BZ(i,1)**CZ(i,1) 2) for XZ1 < x ≤ XZ2, σ_z = AZ(i,2)*BZ(i,2)**CZ(i,2) 3) for XZ2 < X, σ_z = AZ(i,3)*BZ(i,3)**CZ(i,3)
	AZ,BZ,CZ	(6,3),(6,3), (6,3)		lines 2-10: (8X, 6E8.0)	
PR009	IPPP,PPVPTG	1,1	0,0.006	(A2,I3,3X,2E8.0)	Switch for use of partial penetration algorithm (0 = do not use, 1 = use); PPVPTG is vertical potential temperature gradient above inversion to be used in partial penetration algorithm
PR010	IBUOY,ALPHA	1,1	1,3.162	(A2,I3,3X,2E8.0)	Switch for use of buoyancy-enhanced dispersion option (0 = do not use, 1 = use); ALPHA is constant used in the algorithm, plume rise/ALPHA = σ_y, σ_z contribution

TABLE 5-3 (Continued)

Name	Variable	Dimension	Default	Format	Description
PRO11	IDMX	1	1	(A2,I3,3X,E8.0)	Switch for use of unlimited mixing height in stable conditions (0 = do not use, 1 = use)
PRO12	ITRANS	1	1	(A2,I3,3X,E8.0)	Switch for use of transitional plume rise (0 = do not use, 1 = use)
PRO13	TERCOR	6	6*0.5	(A2,I3,3X,6E8.0)	Stability-dependent values of plume path correction factor
PRO14	RVPTG	2	0.02,0.035	(A2,I3,3X,2E8.0)	Default vertical potential temperature gradient values for stabilities 5 and 6
PRO15	ITIPD	1	0	(A2,I3,3X,E8.0)	Switch for use of stack-tip downwash algorithm (0 = do not use, 1 = use)
PRO16	IY	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly turbulence intensity data to compute σ_y (0 = do not use, 1 = use)
PRO17	IZ	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly turbulence intensity data to compute σ_z (0 = do not use, 1 = use)
PRO18	IRVPTG	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly VPTG data for plume rise calculations (0 = do not use, 1 = use)
PRO19	IHVPTG	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly VPTG data for H_{crit} calculations (0 = do not use, 1 = use)
PRO20	ISHEAR,SHCOEF	1,1	0,0.17	(A2,I3,3X,E8.0)	Switch for use of hourly horizontal wind shear data for σ_y calculations (0 = do not use,1 = use)
PRO21	IEPS	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly wind speed profile exponents (0 = do not use, 1 = use)
PRO22	IREFL	1	1	(A2,I3,3X,E8.0)	Switch for use of partial reflection algorithm (0 = do not use, 1 = use)
PRO23	IHORIZ,SECTOR	1	2	line 1: (A2,I3,3X,E8.0)	Switch for use of a horizontal distribution function (1 = off-centerline for all stabilities, 2 = sector averaging for all stabilities, 3 = sector averaging for stable hours, off-centerline for non-stable hours); stability dependent sector widths (deg)
		6	6*22.5	line 2: (8X,6E8.0)	
PRO24	IEMIS	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly stack emissions data (0 = use constant values, 1 = use hourly values)
PRO25	IVERB	1	0	(A2,I3,3X,E8.0)	Switch for use of verbose, case-study output (0 = do not use, 1 = use)

TABLE 5-4

RECOMMENDED RTDM PARAMETERS FOR GENERAL USE ("DEFAULT MODE")

Parameter	Recommendation
PR001	Application-specific
PR002	Application-specific
PR003	Application-specific
PR004	ZWIND1 (height of wind measurements): set to height of anemometer above tower base. ZWIND2 (height of a second anemometer): ignore; use 0. IDILUTE: set to 1. Wind speed will be extrapolated to plume height. ZA (effective displacement of meteorological tower base above stack base elevation): set to 0.0 if the elevation of the tower base is close to that of plant grade or is in a flat area somewhat distant from the site (e.g., at an airport). Nonzero values of ZA are possible: 1) Negative values for anemometers at heights below plant grade or is "sheltered" locations; 2) Positive values for anemometers at heights well above plant grade. Determination of nonzero values of ZA must be done on a case-by-case basis.
PR005	Stability-dependent wind speed profile exponents: if no on-site or other relevant profile data are available, use default values.
PR006	Stability-dependent dispersion parameters: use default value (3, for ASME) if no on-site turbulence data are available to supercede this selection. The use of ASME (after Briggs) dispersion parameters as default values is consistent with the use made of turbulent intensity data in RTDM if such data were available. This is because the functional dependence of calculated sigmas with downwind distance that is coded in RTDM, and which is used in the computation of sigmas from turbulent intensity data, is based on the Briggs curves.
PR007 and PR008	Dispersion parameters: use defaults (these are user-supplied default power law coefficients for sigma-y and sigma-z and are ignored if PR006 is set to 3).

TABLE 5-4 (continued)

Parameter	Recommendation
PR009	Partial penetration: use default value of 0 (which will bypass this option).
PR010	Buoyancy-induced dispersion: use default values which will employ this option.
PR011	Unlimited mixing height: use default value of 1 which will specify an unlimited height for stable conditions.
PR012	Transitional plume rise: use default value of 1 which will cause this feature to be used.
PR013	Stability-dependent values of the plume path correction factor: use default values (0.5 for all stability classes). In stable conditions, RTDM will use 0.0 on an hourly basis if the plume is below the critical dividing streamline height.
PR014	Stable vertical potential temperature gradient values: use default values if data not available to override.
PR015	Stack-tip downwash: set to 1 which will cause this feature to be used.
PR016	Use of hourly turbulence intensity data, horizontal components: set this option value to 0 if no I_y (or σ_θ) data are available near stack-top height. Note: See caution in Section 2-5 concerning use of on-site turbulence data.
PR017	Use of hourly turbulence intensity data, vertical component: set this option value to 0 if no I_z (or σ_ϕ) data are available near stack-top height. Note: See caution in Section 2-5 concerning use of on-site turbulence data.
PR018	Use of hourly vertical potential temperature gradient data for plume rise calculations: set to 0 if vertical temperature difference data are not available. Note: See caution in Section 2-12 concerning use of on-site VPTG data.
PR019	Use of hourly VPTG data for H_{crit} computations: set to 0 if vertical temperature difference data are not available. Note: See caution in Section 2-12 concerning use of on-site VPTG data.

TABLE 5-4 (continued)

Parameter	Recommendation
PR020	Use of hourly horizontal wind shear data: specify 0 if multiple levels of wind direction data are not available. Note: See caution in Section 2.8 concerning use of horizontal wind shear.
PR021	Use of hourly wind speed profile exponents: specify 0 if no data are available or 1 (use) if two or more wind speed levels are available. This specification requires user computation of hourly profile exponents; details are provided in the RTDM manual and must take into account the choice of ZA (PR004).
PR022	Use of the partial reflection algorithm: specify 1 which will cause this algorithm to be used.
PR023	Mode of horizontal distribution function: use an option value of 2 (sector average distribution for all stabilities) and use 22.5° for sector width if PR016 is set to 0 (no I_y data).
PR024	Use of hourly stack emissions data: application specific.
PR025	Case-study printout: application specific.

6) pollution emission rate (g/sec)
7) stack gas exit velocity (m/sec)
8) stack gas exit temperature (°K)

A maximum of 35 sources can be input to RTDM.

As described in Section 3.2, constant emission parameter values specified in the STACKS section can be overridden by use of hourly emissions data. If hourly data exist for some stacks but not others, the hourly values for the stacks with modeled constant emissions should be set to -999. Intermittent missing values in the hourly data are replaced by the last good hourly value.

STACKS Input Format

First Line - The keyword STACKS, is placed in columns 1 to 6.

Second Line - The common x, y, and base elevation coordinates of all stacks are placed in columns 1-10, 11-20, and 21-30, respectively. A 4-character pollutant name is left-justified in columns 31-34.

Successive Lines - Specific stack information is included in one line per stack, as follows:

Columns	Data
1-4	Stack name
11-20	Stack height above common stack base, m
21-30	Stack top diameter, m
31-40	Stack gas exit velocity, m/sec
41-50	Stack gas temperature, °K
51-60	Emission rate, g/sec

Last Line - The list of stacks characteristics is terminated by a line with 99999 in columns 1 to 5.

An example of a STACKS section is shown as part of Figure 5-1.

5.1.3 POINTS Keyword

Locations of receptor points are specified in the POINTS section. The x, y, and elevation coordinates of the receptors are input in user units. Up to 400 receptors may be used in a single RTDM run, and they may be placed in an arbitrary geometric pattern. All receptors are assumed to be at ground level.

POINTS Input Format

First Line - The keyword POINTS is placed in columns 1 to 6 of this line.

Successive Lines - One line is allocated for each receptor location.

The receptor data is specified as follows:

Columns	Data
11-20	x coordinate, user units
21-30	y coordinate, user units
31-40	elevation, user units
41-72	optional receptor name or code

Last Line - The list of receptor information is terminated by a line with 99999 in columns 1 to 5.

An example of a POINTS section is shown as part of Figure 5-1.

5.1.4 TERRAIN Keyword

The TERRAIN section is used to inform RTDM of the local terrain height in all directions from the source location. This keyword must be used even if the partial reflection option is not employed in order to define hill heights in all directions. If partial reflection is used, RTDM must examine concentrations along the path of the plume from the source to the receptor, and it is necessary to use information about terrain heights along this path.

The procedure used to obtain the terrain heights is shown in Figures 2-3 and 2-4. On a topographic map that includes the location of the source and all surrounding terrain points of interest, radial lines should be drawn from the source in each of 36 directions at 10° intervals. The directions referred to in the figures follow meteorological convention; they are the directions from which the wind would blow to transport a plume from the source along the designated radial. A minimum contour level should be selected that is slightly lower than the lowest stack-top elevation. This selection insures that all terrain for plume path calculations is input to RTDM. A maximum hill height to be considered among all directions should be selected to determine the maximum range between the highest and lowest elevations to be specified. A convenient terrain contour interval is then selected so that a total of 20 or fewer equally spaced elevations (19 or fewer intervals) will span the elevation difference between the minimum and maximum values to be specified. In the example shown in Figures 2-3 and 2-4, an interval of 100 feet was chosen for a maximum elevation span between 1100 and 3000 feet. The contour interval should be chosen to make it easy for the user to find the location of each contour on the map, starting at the minimum elevation.

Starting at the lowest contour interval common to all directions, the RTDM user should record the distance in kilometers from the source location to the contour line. The shortest distance to each contour is recorded if the contour is encountered more than once due to dips in elevation along any radial. The user should ordinarily stop at the contour interval just below the hill top in each direction. RTDM will assume that the terrain slope of the last reported interval is similar to the slope between the last contour and the actual top of the hill if a model receptor is located above the last reported contour level. If fewer than 20 terrain heights are referred to in any direction, a -999. value should be added after the last distance to a real terrain contour.

TERRAIN Input Format

First Line - The keyword TERRAIN is placed in columns 1 to 7 of this line.

Second Line - The second line contains the elevation of the starting contour (columns 1-10) and the contour increment (columns 11-20), both in user units.

Next 72 Lines - Each direction requires 2 lines of data, even if not all contour increments are entered. The wind direction required to transport a plume to the terrain in question (see Figure 2-3) is specified in columns 1-3 of the first line, starting with 10°. Downwind distances (km) to the first 10 contour heights are entered in columns 11-17, 18-24, 25-31, ..., 74-80 (7 columns per value). Downwind distances to the last 10 contour heights are entered in the same columns of the second line. A -999. value signals that terrain top has been reached, and all values beyond that point for that direction are ignored (the user should have that space blank).

Last Line - The last line should contain 99999 in columns 1 to 5.

An example of a TERRAIN section is shown as part of Figure 5-1.

5.1.5 EXECUTE Keyword

The EXECUTE keyword should be placed after the PARAMETERS, STACKS, POINTS, and TERRAIN sections. RTDM starts to read the input data files at this point and processes each hour of data until an end-of-file is encountered in the input data.

EXECUTE Input Format

First Line - The keyword EXECUTE is placed in columns 1-7 of this line.

Second Line - The second line contains initial persistence values for each meteorological input parameter. These values are used only if the first hour(s) of data indicates a missing value for any parameter. The format of each data item matches that described in Section 3.1.

Columns	Initial Persistence Parameter
9-14	wind direction
15-20	wind speed (#1), user units
21-26	mixing height, m
27-32	stability class
33-38	ambient temperature, °F
39-44	turbulence intensity, y-component
45-50	turbulence intensity, z-component
51-56	VPTG, plume rise (°C/m)
57-62	VPTG, H_{crit} (°C/m)
63-68	horizontal wind shear (deg/meter)
69-74	wind speed profile exponent
75-80	alternate wind speed, user units

The RTDM user can force an input value to stay constant throughout the entire run by inserting -999. for that value for each hour in the meteorological input file. The value specified in the EXECUTE section is then used for all hours modeled.

Optional Last Line - The user may insert a line with ENDJOB in columns 1 to 6 as the last line in the input run stream.

5.2 RTDM Output

The information input by the user in the PARAMETERS, STACKS, POINTS and TERRAIN sections is displayed in the RTDM output. The specifications of each of the 25 RTDM parameter groups is displayed, whether altered by the user from the default values or not. All stack characteristics and receptor location information are also displayed. The table of distances to terrain contours in each of 36 directions is given. The terrain information is accompanied by a computer-plotted map with letter codes for terrain contours, and specification of the location of the source and receptors. An example of RTDM output is given in Figure 5-2.

It is recommended that the user execute a short run with the case-study output option employed prior to a long run with this

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        MODEL PARAMETERS:

        PR001:  HORIZONTAL SCALE IS 1000.000 METERS PER USER UNIT

        PR002:  VERTICAL SCALE IS      .305 METERS PER USER UNIT

        PR003:  WIND SPEED SCALE IS     1.000 M/SEC PER USER UNIT

        PR004:  ANEMOMETER #1 HEIGHT ABOVE ZA (USED FOR PLUME RISE) IS  10.0 M
                IF AVAILABLE, ANEMOMETER #2 HEIGHT ABOVE ZA (USED FOR PLUME DILUTION) IS     .0 M
                DILUTION WIND SPEED OPTION IS 0       (IF 0, ONE WIND SPEED--AT STACK HEIGHT--IS USED FOR PLUME RISE AND DILUTION
                IF 1, WIND SPEED AT LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE AND TO PLUME HEIGHT FOR DILUTION
                IF 2, WIND SPEED AT LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE,
                AND THE SPEED AT LEVEL #2 IS EXTRAPOLATED TO PLUME HEIGHT FOR DILUTION)
                ZA (HEIGHT IN METERS ABOVE STACK BASE ELEVATION WHERE THE WIND SPEED PROFILE IS ASSUMED TO ORIGINATE) =      .000

        PR005:  DEFAULT WIND SPEED PROFILE EXPONENTS AS A FUNCTION OF STABILITY CLASS (1-6, RESPECTIVELY):
                          .0900   .1100   .1200   .1400   .2000   .3000

        PR006:  DISPERSION COEFFICIENTS ARE BRIGGS RURAL/ASME-1979 (UNLESS REPLACED BY ON-SITE TURBULENCE DATA).

        PR009:  PARTIAL PLUME PENETRATION OF MIXING LIDS IS NOT BEING USED.

        PR010:  BUOYANCY-ENHANCED PLUME DISPERSION IS USED; PARAMETER ALPHA IS     3.162

        PR011:  UNLIMITED MIXING HEIGHT USED FOR STABLE CONDITIONS

        PR012:  TRANSITIONAL PLUME RISE IS USED.

        PR013:  PLUME PATH COEFFICIENTS FOR STABILITY CLASSES 1-6:   .500  .500  .500  .500  .500  .500

        PR014:  DEFAULT VERTICAL POTENTIAL TEMPERATURE GRADIENTS USED FOR STABLE PLUME RISE (CLASSES 5 & 6):   .0200  .0350

        PR015:  STACK-TIP DOWNWASH IS NOT USED.

        PR016:  Y-COMPONENT TURBULENCE INTENSITY VALUES ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Y.

        PR017:  Z-COMPONENT TURBULENCE INTENSITY VALUES ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Z.

        PR018:  HOURLY VERTICAL POTENTIAL TEMPERATURE GRADIENTS ARE PROVIDED FOR COMPUTING STABLE PLUME RISE.

        PR019:  HOURLY VERTICAL POTENTIAL TEMPERATURE GRADIENTS ARE PROVIDED FOR COMPUTING HCRIT.

        PR020:  WIND DIRECTION SHEAR IS USED IN COMPUTATION OF SIGMA-Y; COEFFICIENT =   .17

        PR021:  HOURLY VALUES OF WIND SPEED PROFILE EXPONENT ARE PROVIDED.

        PR022:  PARTIAL REFLECTION ALGORITHM IS BEING USED; KEYWORD TERRAIN MUST BE USED TO READ IN TERRAIN.

        PR023:  OFF-CENTERLINE CONCENTRATIONS ARE COMPUTED FOR ALL STABILITIES; NO SECTOR AVERAGING IS USED.

        PR024:  HOURLY EMISSIONS DATA ARE NOT AVAILABLE; CONSTANT VALUES SPECIFIED IN THE STACKS SECTION ARE USED.

        PR025:  DETAILED INFORMATION ABOUT EACH CASE WILL BE PRINTED.
```

Figure 5-2

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      MODELED STACK PARAMETERS:


      X,Y COORDINATE OF ALL SOURCES (USER UNITS) IS (    600.00 ,     800.00 )  OR  ( 600000.00 ,  800000.00) METERS
      BASE HEIGHT OF ALL SOURCES (USER UNITS) IS    765.000 OR    233.172 METERS
      POLLUTANT IS SO2


      CODE NAME   STACK HT (M)   DIAMETER (M)   EXIT VEL (M/SEC)  STACK TEMP (K)  EMISSION RATE (G/SEC)

     1   STK1       121.920         5.000           20.000          370.000            1000.000
```

Figure 5-2 (cont.)

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      RECEPTOR POINT INFORMATION (ALL COORDINATES IN USER UNITS):

      RECEPTOR      X-COORD     Y-COORD     HEIGHT      NAME

          1          603.16      801.61     2782.00** WEST MT.
          2          602.75      799.90     2430.00** BRUSH MT.
          3          603.46      799.41     2520.00** WALKER MT.
          4          600.53      800.63     1100.00
          5          600.64      800.76     1200.00**
          6          600.80      800.96     1300.00**
          7          600.85      801.01     1400.00**
          8          600.96      801.14     1500.00**
          9          601.09      801.30     1600.00**
         10          601.31      801.56     1700.00**
         11          601.43      801.70     1800.00**
         12          601.61      801.92     1900.00**
         13          601.84      802.19     2000.00**
         14          603.59      804.27     2100.00**
         15          603.70      804.40     2200.00**
         16          603.89      804.63     2300.00**
         17          603.93      804.68     2400.00**
         18          603.96      804.72     2500.00**
         19          603.98      804.74     2600.00**
         20          603.99      804.76     2700.00**
         21          604.00      804.77     2800.00**
         22          604.03      804.80     2900.00**
         23          604.04      804.82     3000.00** TUMBLEDOWN MT.
         24          603.35      793.70     1631.00** BUNKER MT.
         25          598.10      798.23     2440.00** RECORD HILL
         26          596.53      799.26     2440.00** OLD TURK MT.
** THIS RECEPTOR IS HIGHER IN ELEVATION THAN THAT OF THE LOWEST STACK TOP.
   SPECIAL ALGORITHMS CONCERNING PLUME IMPINGEMENT AND REFLECTION MAY INFLENCE CONCENTRATIONS MODELED AT THIS RECEPTOR.
```

Figure 5-2 (cont.)

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        TERRAIN INFORMATION:

                  TABLE OF DISTANCES (KM) FROM THE SOURCE TO ELEVATION CONTOURS AS A FUNCTION OF WIND DIRECTION

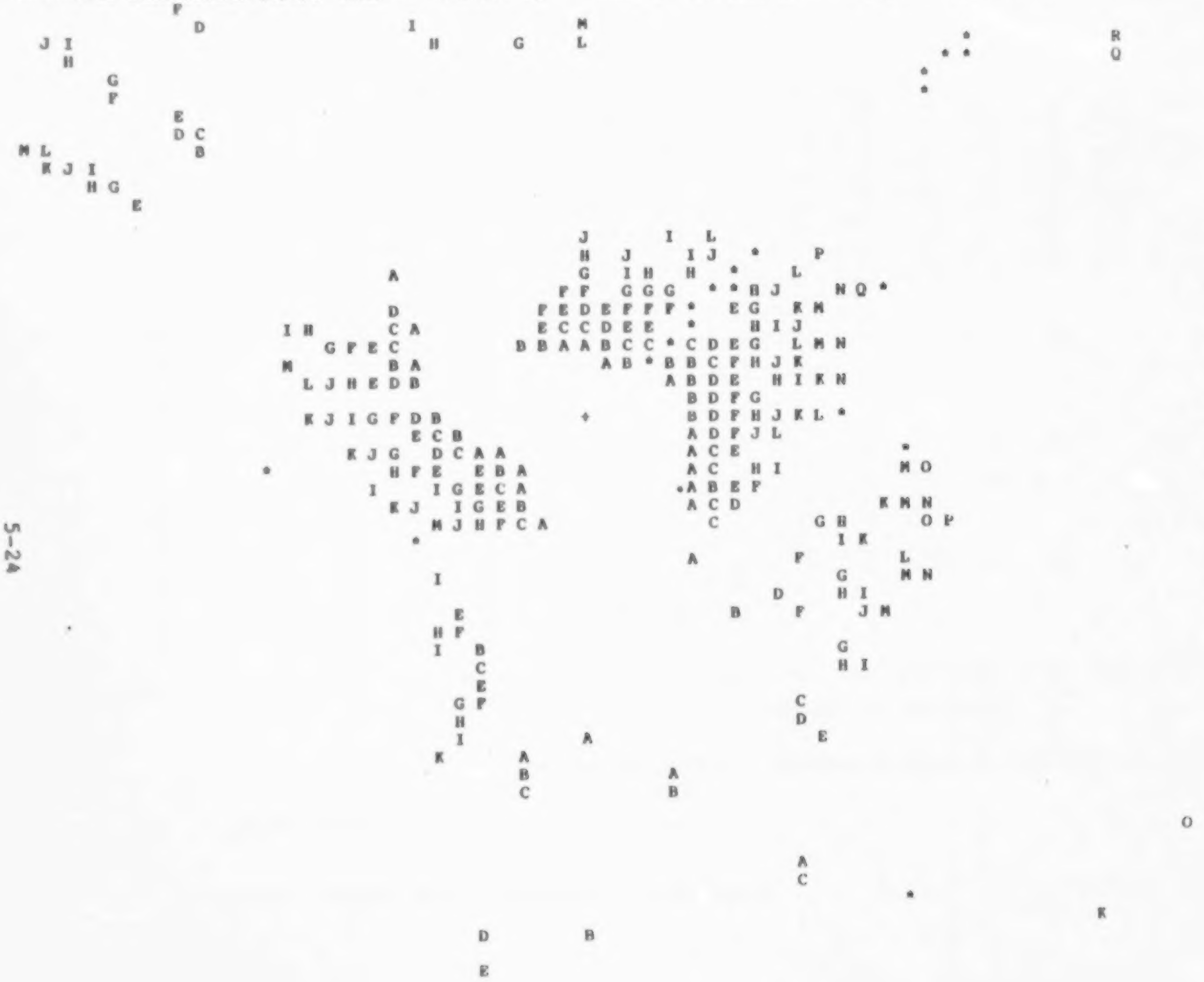
                                                            ELEVATION IN USER UNITS:

WIND DIR.   1100. 1200. 1300. 1400. 1500. 1600. 1700. 1800. 1900. 2000. 2100. 2200. 2300. 2400. 2500. 2600. 2700. 2800. 2900. 3000.

    10       4.46  4.78  5.01  7.00  7.38
    20       1.50  3.35  3.45  3.75  3.85  3.95  4.05  4.20  4.60  4.70  4.80
    30       1.40  1.50  1.65  3.00  3.10  3.16  3.24  3.31  3.50
    40       1.28  1.40  1.46  1.53  1.61  1.74  1.88  1.98  2.72
    50       1.15  1.30  1.39  1.49  1.60  1.69  1.75  1.82  1.94  2.06  2.13  2.22  2.34
    60       1.18  1.29  1.40  1.48  1.58  1.69  1.80  1.94  2.10  2.24  2.58
    70       1.25  1.47  1.60  1.72  1.87  2.03  2.20  2.32  2.47
    80       1.41  1.58  1.70  1.87  2.00  2.12  2.24  2.38  2.44  2.49  2.59
    90       1.64  1.75  1.88  1.99  2.09  2.20  2.39  2.59  2.76  2.94  3.08
   100       1.99  2.09  2.18  2.30  2.52  2.59  2.66  2.71  2.81  2.95  3.09  3.18  3.29
   110       2.02  2.28  2.40  2.52  2.63  2.72  3.00  3.19  3.55
   120       2.21  2.41  2.52  2.63  5.75  5.90  6.01  6.18  6.30  6.50  6.73  6.85  7.07
   130       2.75  5.47  5.62  5.92  6.01  6.70  6.90  7.37  7.48  7.79
   140       1.22  1.29  6.70  6.80  6.90  7.00
   150       1.11  1.19  1.24  1.29  1.32
   160       1.08  1.15  1.21  1.28  1.38  1.42  5.13  5.32  5.51
   170       1.01  1.12  1.23  1.34  1.48  1.53  4.98
   180        .81  1.04  1.18  1.38  1.51  1.66  1.82  2.10  2.23  2.31  4.79  4.92  5.05
   190        .79   .90  1.07  1.23  1.37  1.50  1.71  1.81  1.91  2.01
   200        .68   .82  1.00  1.16  1.30  1.50  1.68  1.95  2.52
   210        .71   .83  1.03  1.20  1.43  1.58  1.81  2.15  2.30  2.52  2.62  2.73
   220        .82   .99  1.25  1.32  1.49  1.70  2.04  2.22  2.50  2.86  5.58  5.75  6.05  6.11  6.16  6.19  6.21  6.23  6.27  6.29
   230       1.05  1.21  1.48  1.61  2.02  2.17  2.28  2.42  2.54  2.67  2.84  3.01  3.17  3.21  3.28  3.32  7.42  7.49
   240       1.05  1.20  1.41  1.61  1.78  1.90  2.04  2.16  2.38  2.52  2.68  2.80  2.91  3.14  3.31  3.39  3.45
   250       1.00  1.23  1.31  1.40  1.56  1.70  1.86  1.97  2.08  2.17  2.30  2.45  2.57  2.80
   260       1.00  1.11  1.27  1.36  1.49  1.60  1.78  2.09  2.27  2.45  2.56  2.63  2.73  2.84
   270       1.03  1.16  1.28  1.38  1.48  1.53  1.66  1.73  1.88  2.09  2.26  2.49  2.61
   280       1.09  1.22  1.34  1.43  1.54  1.63  1.71  1.76  1.82  1.89  1.97  2.10  3.50  3.58  3.70
   290       1.16  1.28  1.43  1.57  1.67  1.76  1.83  1.98  2.13  3.26  3.34  3.50  3.65  3.79  3.90  4.05
   300       1.28  1.41  1.60  1.74  1.89  2.10  2.90  3.01  3.16  3.24  3.33  3.96  4.03  4.17
   310       1.46  1.60  1.75  1.90  2.90  3.04  3.42  3.59  3.75  3.90  3.98  4.08  4.20  8.25  8.35
   320       1.65  1.85  2.00  3.12  3.36  3.49  4.05  4.20  4.42  8.55  8.65
   330       2.18  2.97  4.42  4.61  4.78
   340       6.23  6.42  6.58
   350       4.69  4.90
   360       4.31  6.80
```

Figure 5-2 (cont.)

```
MAP OF USER-SPECIFIED TERRAIN:  LETTERS (SOME OVERWRITTEN) DENOTE ELEVATIONS (SEE TABLE); "+" = SOURCE; "*" = A RECEPTOR POINT
   DISTANCES FROM SOURCE (0,0):  XMIN =  -6122.79 M,     XMAX =   6396.47 M,     YMIN =  -7267.88 M,     YMAX =   5362.32 M
```



```
CONTOUR
CODES

A  1100.00
B  1200.00
C  1300.00
D  1400.00
E  1500.00
F  1600.00
G  1700.00
H  1800.00
I  1900.00
J  2000.00
K  2100.00
L  2200.00
M  2300.00
N  2400.00
O  2500.00
P  2600.00
Q  2700.00
R  2800.00
S  2900.00
T  3000.00
```

Figure 5-2 (cont.)

```
ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 361130                                        PAGE   6

THE CODE FOR MISSING DATA IS PRESENTED AS FOLLOWS:
  A "1" IS INCLUDED IF WIND DIRECTION IS MISSING,
  A "2" IS INCLUDED IF WIND SPEED IS MISSING,
  A "3" IS INCLUDED IF MIXING HEIGHT IS MISSING,
  A "4" IS INCLUDED IF STABILITY CLASS IS MISSING,
  A "5" IS INCLUDED IF AMBIENT TEMPERATURE IS MISSING.
  IF THERE IS MISSING DATA FOR ANY OF THESE PARAMETERS, THE PREVIOUS GOOD VALUE IS USED.
  IF THERE IS MISSING DATA FOR OPTIONAL PARAMETERS, THE DEFAULT VALUE (OBTAINED FROM THE STABILITY CLASS) IS USED.


--------------------------------------------------------------------------------------------------------------------------

CASE-HOUR #    1            YEAR, DAY, HOUR: 76 365 24
             WIND      MIXING                  AIR      TURB.      TURB.       VPTG,       VPTG,     DELTA      WSPD       WIND
   WIND    SPEED #1    HEIGHT    STABILITY    TEMP   INTENSITY  INTENSITY     PLUME       HCRIT      THETA     PROFILE   SPEED #2
DIRECTION  (M/SEC)      (M)        CLASS       (K)       (Y)        (Z)      (DEG K/M)  (DEG K/M)   (DEG/M)   EXPONENT   (M/SEC)

   220.       1.00     3000.         1       293.15     .2200*     .2000*     .0000      .0000      .1000      .0900      2.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =      .00 M
UTOP =  1.25 M/SEC,    FLUX =    254.59 M**4/S**3,  FINAL RISE =  858.18 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00

                                                                                                      CONVENTIONAL REFLECTION
                     HT                                                                                              
                   ABOVE PLUME HT   PLUME HT            SIGMA-Y                      SIGMA-Z          HORIZ.   VERTICAL    VERTICAL          CHI
                   STACK  BEFORE   CORRECTED                                                           DIST.     DIST.       DIST.
REC    X      Y    BASE   TERRAIN  BY TERRAIN   AMBIENT BUOY  SHEAR   TOTAL  AMBIENT  BUOY   TOTAL  FACTOR     FACTOR      FACTOR           (UG/
 #   (KM)   (KM)    (M)     (M)       (M)         (M)    (M)    (M)     (M)     (M)     (M)     (M)   (1/M)      (1/M)       (1/M)       R   M**3)

  1  3.26  -1.39  615.    980.10    672.71      623.6 271.4   831.  1073.9   652.9  271.4   707.1 .00016  .71766E-03  .71766E-03 1.27    93.
  2  1.69  -2.17  507.    980.10    726.36      344.1 271.4   430.   614.3   338.2  271.4   433.6 .00000  .45240E-03  .92340E-03 1.00     0.
  4   .82    .00  102.    833.12    782.06      174.1 224.9   174.   333.2   164.6  224.9   278.7 .00120  .55868E-04  .14313E-02 1.00    53.
  5   .99    .00  133.    928.10    861.81      208.5 254.9   238.   406.1   198.7  254.9   323.2 .00098  .70586E-04  .12343E-02 1.00    55.
  6  1.25    .00  163.    980.10    898.57      259.2 271.4   318.   492.0   249.9  271.4   368.9 .00081  .11139E-03  .10813E-02 1.00    72.
  7  1.32    .00  194.    980.10    883.33      273.0 271.4   336.   511.0   264.0  271.4   378.6 .00078  .13863E-03  .10536E-02 1.00    86.
  8  1.49    .00  224.    980.10    868.09      305.9 271.4   379.   557.8   298.0  271.4   403.1 .00072  .19472E-03  .98972E-03 1.00   111.
  9  1.70    .00  255.    980.10    852.85      345.1 271.4   432.   615.9   339.3  271.4   434.5 .00065  .26750E-03  .91859E-03 1.00   138.
 10  2.04    .00  285.    980.10    837.61      408.5 271.4   519.   713.8   407.4  271.4   489.5 .00056  .37709E-03  .81727E-03 1.00   168.
 11  2.22    .00  315.    980.10    822.37      442.1 271.4   566.   767.4   444.3  271.4   520.6 .00052  .44014E-03  .77152E-03 1.01   183.
 12  2.51    .00  346.    980.10    807.13      492.9 271.4   638.   850.6   501.1  271.4   569.9 .00047  .51356E-03  .71269E-03 1.02   192.
 13  2.86    .00  376.    980.10    791.89      554.9 271.4   728.   954.9   572.1  271.4   633.2 .00042  .57645E-03  .66065E-03 1.05   192.
 14  5.58   -.01  407.    980.10    776.65      983.3 271.4  1420.  1748.6  1115.7  271.4  1148.3 .00023  .55289E-03  .55289E-03 1.59   101.
 15  5.75   -.01  437.    980.10    761.41     1007.8 271.4  1464.  1797.6  1149.8  271.4  1181.3 .00022  .54890E-03  .54887E-03 1.63    97.
 16  6.05    .00  468.    980.10    746.17     1050.2 271.4  1539.  1883.2  1209.4  271.4  1239.5 .00021  .53741E-03  .53741E-03 1.67    91.
 17  6.11    .00  498.    980.10    730.93     1059.2 271.4  1556.  1901.6  1222.2  271.4  1252.0 .00021  .53788E-03  .53784E-03 1.69    90.
 18  6.16    .00  529.    980.10    715.69     1066.2 271.4  1568.  1915.9  1232.2  271.4  1261.8 .00021  .53892E-03  .52714E-03 1.67    88.
 19  6.19    .00  559.    980.10    700.45     1070.2 271.4  1576.  1924.0  1237.9  271.4  1267.3 .00021  .54100E-03  .52485E-03 1.67    87.
 20  6.21    .00  590.    980.10    685.21     1073.2 271.4  1581.  1930.2  1242.2  271.4  1271.5 .00021  .54333E-03  .52310E-03 1.67    86.
 21  6.23    .00  620.    980.10    669.97     1075.2 271.4  1585.  1934.2  1245.0  271.4  1274.3 .00021  .54600E-03  .52197E-03 1.67    86.
 22  6.27    .00  651.    980.10    654.73     1081.1 271.4  1596.  1946.3  1253.5  271.4  1282.5 .00020  .54688E-03  .51860E-03 1.67    85.
 23  6.29    .00  681.    980.10    639.49     1084.1 271.4  1601.  1952.6  1257.9  271.4  1286.8 .00020  .54886E-03  .51688E-03 1.67    84.
         WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366   4

--------------------------------------------------------------------------------------------------------------------------
```

Figure 5-2 (cont.)

printout option. The output of the short run can then be examined to verify that all input data read by RTDM is correct.

For each hour processed, RTDM writes the input meteorology and the receptor concentrations to a disk file. The ANALYSIS post-processor reads this file and produces summary statistics (see Section 6). The user can also obtain printouts of plume characteristics and plume-receptor geometry for each hour by activating the verbose mode (parameter group 25). An example of this printout is shown in Figure 5-2.

Errors made by the user in entering data in the PARAMETERS, STACKS, POINTS, TERRAIN, or EXECUTE sections are identified by self-explanatory error messages. In most cases, the errors are fatal and the program execution terminates.

5.3 Computer Job Control Considerations

Several input/output files are involved in an RTDM run. They are described below, along with suggested file names associated with FORTRAN "OPEN" statements.

Unit #	File Name	File Description
5	"@DATA"	Input run stream (see Section 5.1)
6	"@LIST"	Output file to be printed (see Section 5.2)
9	"CONC.TP"	Output disk file containing receptor concentrations and input meteorology for each hour
7	"METFILE"	Hourly meteorological data (see Section 3.1)
8	"EMISFILE"	Optional hourly emissions data (see Section 3.2)

The RTDM program consists of 22 routines. The flow of the program and routines involved in each step are described in Table 5-5.

TABLE 5-5

FUNCTIONS OF RTDM ROUTINES

Routine Group	Descriptions of Functions
RTDM	Main program; reads keywords and calls subroutines
BLKFIX, INPAR, WRPAR	Sets defaults in parameter groups, reads user-specified parameter values and prints parameter settings
STACKS	Reads and prints stack information
POINTS	Reads and prints receptor information
TERRAIN	Reads and prints terrain information, prints a terrain receptor map.
RTXEQ	Reads hourly meteorological and emissions data
CONC	Calculates hourly concentrations, calls several subroutine groups listed below
PRISE, PENETRATE	Computes plume rise, determines fraction of the plume that penetrates the mixing lid
PSRCE	Computes horizontal position of plume relative to receptor
SIGMAY, SIGMAZ, BRIGGS, PGYZ	Calculates σ_y, σ_z
VERT, DOWNWD, VDF	Determines plume behavior near terrain, partial reflection factor
WRCONC, PAGE, LINES	Writes concentrations to disk file, creates file for printout

6. GUIDE TO THE USE OF THE POSTPROCESSOR PROGRAM - "ANALYSIS"

6.1 General Description

After RTDM is run, the resultant disk file of concentration values can be processed by one or more of the subroutines in the program ANALYSIS. The five subroutines are as follows:

Keyword	Function
TOPVAL	Displays, by receptor, the top n-hour average concentrations together with the day and hour of occurrence.
CUMFREQ	Reads a sequence of hourly concentrations and tabulates the average concentrations and cumulative frequencies of n-hour averages for each receptor.
PEAK	Reads a sequence of hourly concentrations and tabulates for each receptor all (non-overlapping) n-hour averages which exceed a specified ambient air quality standard.
AVERAGES	Reads a sequential concentration data set and averages these values, where "n" is any integer greater than 1 up to 24. Results are stored in a binary file as running (overlapping) n-hour averages.
SEQADD	Reads up to 5 sequential concentration files and adds hourly concentrations from each. A scale factor can be applied to

each data set independently. The hourly sum is written to a new concentration file.

6.2 TOPVAL

6.2.1 Description

The analytical tool TOPVAL is used to display the highest average concentrations which are predicted to occur at each receptor. The number of top values calculated is user-specified; however, the number of receptors (NR) multiplied by the number of top concentration levels (NM) must be $\leq$ 2,500. For example, if concentrations were calculated at 250 receptors, then:

$$NM = \frac{2{,}500}{NR}$$

$$= \frac{2{,}500}{250}$$

$$NM = 10$$

Thus, the maximum number of top values which can be specified in this instance is ten. The number of receptors to be processed is specified in the TOPVAL input.

The averaging period for which TOPVAL calculates concentrations is also user specified for any period of hours up to 24. TOPVAL will then calculate blocks of n-hour average concentrations from the first hour to the last, arrange these values from the highest to lowest for each receptor, and display the concentrations with the corresponding day and hour of occurrence. This day and hour specify the ending hour of the time period. The first hour in the file is referenced as day one and hour one. In addition, TOPVAL lists the 25 highest and highest, second-highest concentrations over the entire field of receptors.

If desired, it is possible to process only the beginning segment of the hourly concentration file by using the variables DAYSIN and HOURSIN. DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

(hours processed) = 24 * DAYSIN + HOURSIN

For example, if only the highest concentrations for Julian days 1-100 are needed from a complete 1-year disk file (which begins on the first hour of January 1st), the following values should be used:

(hours processed) = 24 * (100) + 0 = 2400

If the averaging time does not divide evenly into the hours to be processed, the program will automatically complete the period by including the next available hours. If no following hours are found, the program will end at the last complete time period and ignore the remaining hours. The total number of processed hours are printed on the output.

6.2.2 Input Stream

This keyword requires 2 data lines.

Line 1:

LP (I5)	(Cols. 11-15):	the number of hours in the averaging period. If omitted or 0, LP is set to 1.
NH (I5)	(Cols. 16-20)	the number of hours represented by each record of the input binary file (default = 1).

NM (I5) (Cols. 21-25): the number of topmost average values to be printed for each receptor. NM must always be specified and must satisfy

$$0 < NM \text{ and}$$

$$NM*NR \leq 2,500$$

where NR is the number of receptors.

DAYSIN (F10.0) (Cols. 26-35): the number of days to be read (if omitted or 0, the file is read from hour = 1 to end-of-file). Defaults to 0.

HOURSIN (F10.0) (Cols. 36-45): the number of hours to be read (if omitted or 0, the file is read from hour = 1 to the end-of-file). Defaults to 0.

DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

$$(hours) = 24 * DAYSIN + HOURSIN.$$

If (hours) = 0 then the file is read to end-of-file. Default values are 0.

Line 2:

NR (I10) (Cols. 11-20): the number of receptors to be processed; must satisfy

$$1 \leq NR \leq 400$$

or program aborts (no default value).

RFACT (F10.1) (Cols. 21-30):	the factor to convert internal concentration units (gm/m^3) to external units for printing (default is for μg/m^3).

See Figure 6-1 for example input.

6.2.3 Input Data

Input data for TOPVAL is composed of the sequential output of RTDM which is stored on disk. TOPVAL will read this binary file using unit 8.

6.2.4 Output

TOPVAL will generate a table with one row for each receptor, where each row represents an ordered sequence of the top NM average values encountered in the file for that receptor. Below each top value, the day and hour of occurrence are printed. The day and hour represent the time of the last hour used in the printed average. The first hour in the file is referenced as day one and hour one. See Figure 6-2 for a sample output.

In the analysis program TOPVAL, this output is designated to a specific output unit (IPUT). This unit is set to 6.

6.2.5 Diagnostics

Four error messages are associated with TOPVAL. These messages are:

"NR OUT OF RANGE"	Indicates that the number of user-specified receptors is < 1 or > 400.

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------


TOPVAL
              1    1    4
                  30  1000000.
99999


--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
```

Figure 6-1 Example of TOPVAL Input Stream

```
    POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30       LEVEL 851125


TOPVAL



          LP   NH   NM    DAYSIN    HOURIN

           1    1    4        0.        0.


               NR   RFACT

               30  1000000.
```

Figure 6-2 Example of TOPVAL Output

```
POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30       LEVEL 851125

TOP   4 CONCENTRATIONS OF  1-HOUR AVERAGES FOR      4. HOURS

RECEPTOR    I   TOP    1 I   TOP    2 I   TOP    3 I   TOP    4 I   TOP
------------+------------+------------+------------+------------+
   1        I  103.9480 I      .0018 I      .0017 I      .0000 I
DAY/HOUR    I   1     4 I   1     1 I   1     3 I   1     2 I
------------+------------+------------+------------+------------+
   2        I    7.4715 I      .0000 I      .0000 I      .0000 I
DAY/HOUR    I   1     4 I   1     1 I   1     3 I   0     0 I
------------+------------+------------+------------+------------+
   3        I  163.4984 I      .0091 I      .0001 I      .0000 I
DAY/HOUR    I   1     4 I   1     1 I   1     3 I   1     2 I
------------+------------+------------+------------+------------+
   4        I  131.7615 I      .0440 I      .0046 I      .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+------------+------------+------------+
   5        I  279.1396 I   11.7389 I     2.9620 I      .0131 I
DAY/HOUR    I   1     4 I   1     2 I   1     3 I   1     1 I
------------+------------+------------+------------+------------+
   6        I  253.2820 I      .1103 I      .0304 I      .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+------------+------------+------------+
   7        I  171.1372 I      .0098 I      .0010 I      .0000 I
DAY/HOUR    I   1     4 I   1     1 I   1     3 I   1     2 I
------------+------------+------------+------------+------------+
   8        I  554.8120 I  252.9272 I     1.2858 I      .0132 I
DAY/HOUR    I   1     2 I   1     4 I   1     3 I   1     1 I
------------+------------+------------+------------+------------+
   9        I  345.8530 I   39.0648 I      .0000 I      .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+------------+------------+------------+
  10        I  359.9045 I   74.2378 I      .0000 I      .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+------------+------------+------------+
  11        I  322.7112 I   45.8592 I      .0000 I      .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+------------+------------+------------+
  12        I  356.3389 I   21.2265 I      .0005 I      .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+------------+------------+------------+
  13        I  337.1736 I   10.1307 I     6.4003 I      .0043 I
DAY/HOUR    I   1     4 I   1     2 I   1     3 I   1     1 I
------------+------------+------------+------------+------------+
  14        I  303.9636 I    7.8294 I      .0018 I      .0017 I
DAY/HOUR    I   1     4 I   1     3 I   1     2 I   1     1 I
------------+------------+------------+------------+------------+
  15        I  314.2187 I  120.3929 I      .0000 I      .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   0     0 I
------------+------------+------------+------------+------------+
  16        I  349.0750 I  110.2221 I      .0000 I      .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   0     0 I
------------+------------+------------+------------+------------+
```

Figure 6-2 (Continued)

```
 POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125


  TOP   4 CONCENTRATIONS OF  1-HOUR AVERAGES FOR     4. HOURS

RECEPTOR    I   TOP    1 I  TOP    2 I  TOP    3 I  TOP    4 I    TOP
------------+------------+-----------+-----------+-----------+
    17      I  329.5166 I   83.7689 I     .0000 I     .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   0     0 I
------------+------------+-----------+-----------+-----------+
    18      I  366.8562 I   85.3995 I     .0000 I     .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   0     0 I
------------+------------+-----------+-----------+-----------+
    19      I  303.7729 I   63.0033 I     .0000 I     .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   0     0 I
------------+------------+-----------+-----------+-----------+
    20      I  187.7819 I    6.9033 I     .0169 I     .0007 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+-----------+-----------+-----------+
    21      I   88.7205 I     .0008 I     .0000 I     .0000 I
DAY/HOUR    I   1     4 I   1     1 I   1     3 I   0     0 I
------------+------------+-----------+-----------+-----------+
    22      I  265.0759 I    1.1402 I     .0202 I     .0003 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+-----------+-----------+-----------+
    23      I  346.9060 I  106.5185 I     .0000 I     .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   0     0 I
------------+------------+-----------+-----------+-----------+
    24      I  193.8985 I    4.2444 I     .0152 I     .0000 I
DAY/HOUR    I   1     4 I   1     3 I   1     1 I   1     2 I
------------+------------+-----------+-----------+-----------+
    25      I     .0000 I     .0000 I     .0000 I     .0000 I
DAY/HOUR    I   0     0 I   0     0 I   0     0 I   0     0 I
------------+------------+-----------+-----------+-----------+
    26      I     .0000 I     .0000 I     .0000 I     .0000 I
DAY/HOUR    I   0     0 I   0     0 I   0     0 I   0     0 I
------------+------------+-----------+-----------+-----------+
    27      I     .0000 I     .0000 I     .0000 I     .0000 I
DAY/HOUR    I   1     3 I   0     0 I   0     0 I   0     0 I
------------+------------+-----------+-----------+-----------+
    28      I     .0032 I     .0029 I     .0000 I     .0000 I
DAY/HOUR    I   1     4 I   1     3 I   0     0 I   0     0 I
------------+------------+-----------+-----------+-----------+
    29      I     .0000 I     .0000 I     .0000 I     .0000 I
DAY/HOUR    I   0     0 I   0     0 I   0     0 I   0     0 I
------------+------------+-----------+-----------+-----------+
    30      I     .0000 I     .0000 I     .0000 I     .0000 I
DAY/HOUR    I   0     0 I   0     0 I   0     0 I   0     0 I
------------+------------+-----------+-----------+-----------+
```

Figure 6-2 (Continued)

```
POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125

              TOP 25 HIGHEST AND SECOND-HIGHEST CONCENTRATIONS

                     HIGHEST                         SECOND-HIGHEST

     RANK      RECEPTOR   CONCENTRATION         RECEPTOR   CONCENTRATION

       1          8          554.812                8         252.927

       2         18          366.856               15         120.393

       3         10          359.905               16         110.222

       4         12          356.339               23         106.519

       5         16          349.075               18          85.400

       6         23          346.906               17          83.769

       7          9          345.853               10          74.238

       8         13          337.174               19          63.003

       9         17          329.517               11          45.859

      10         11          322.711                9          39.065

      11         15          314.219               12          21.226

      12         14          303.964                5          11.739

      13         19          303.773               13          10.131

      14          5          279.140               14           7.829

      15         22          265.076               20           6.903

      16          6          253.282               24           4.244

      17         24          193.899               22           1.140

      18         20          187.782                6            .110

      19          7          171.137                4            .044

      20          3          163.498                7            .010

      21          4          131.761                3            .009

      22          1          103.948               28            .003

      23         21           88.721                1            .002

      24          2            7.471               21            .001

      25         28             .003                2            .000
```

Figure 6-2 (Continued)

"NM * NR OUT OF RANGE" Indicates that the number of user specified top concentrations requested is greater than $\frac{2,500}{NR}$ where NR = the number of receptors.

"ILLEGAL DATA LINE" Indicates an error was found in the TOPVAL input stream.

"UNEXPECTED END OF CONCENTRATION FILE" Indicates that a premature end-of-file was found in the binary concentration file.

6.3 CUMFREQ

6.3.1 Description

CUMFREQ can be used to tabulate the average concentrations and cumulative frequencies of occurrence for any averaging period for each receptor. A maximum of 400 receptors and 20 frequency levels can be specified. Each frequency level which is input denotes an upper bound, such that the program calculates the percentage of concentrations less than or equal to that level.

The analysis also includes:

all remaining occurrences > NLEV (last)

If desired, only the beginning of the input hourly concentration file can be processed using the variables DAYSIN and HOURSIN. DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

(hours processed) = 24 * DAYSIN + HOURSIN

It should be noted that the first hour in the hourly concentration file is referenced as day one and hour one. (See example in Section 6.2.1.) If the averaging time does not divide evenly into the hours to be processed, the program will automatically complete the period by including the next available hours. If no following hours are found, the program will end at the last complete time period and ignore the remaining hours. The total number of processed hours are printed on the output. The CUMFREQ program will also output average concentration values for the user-specified averaging time period. When a partial concentration file is specified for analysis, the concentrations are averaged for that portion of the file only.

6.3.2 Input Stream

Input:

This keyword requires a first input line and may have up to 5 additional lines.

Line 1:

HOURSIN (F10.0) (Cols. 21-30):	the number of hours to be read (if omitted or 0, the file is read from hour = 1 to end of file). Defaults to 0.
DAYSIN (F10.0) (Cols. 31-40):	the number of days to be read (if omitted or 0, the file is read from hour = 1 to end of file). Defaults to 0.

DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

(hours processed) = 24 * DAYSIN + HOURSIN

If (hours) = 0 then the file is read to end of file. Default values are 0.

RFACT (F10.0)	(Cols. 51-60):	the factor which converts internal units (gm/m^3) to external units (which default is $\mu g/m^3$). The levels for frequency tabulations must be in these external units.
NHR (I10)	(Cols. 61-70):	the number of hours in the averaging period (if omitted or 0, NHR = 1 is assumed).
NLEV (I5)	(Cols. 71-75):	the number of levels (where $0 < NLEV \leq 20$). A zero indicates that only averages will be calculated.
NR (I5)	(Cols. 75-80):	the number of receptors must satisfy $1 < NR \leq 400$.

Lines 2-5 (10X, 6F10.1):

The next input line (and as many others as are needed) contain NLEV levels, 6 per line, in the 10 column fields beginning in column 11 and ignoring columns 71 to 80. See Figure 6-3 for a sample CUMFREQ package.

6.3.3 Input Data

The input data for CUMFREQ is composed of the sequential output from RTDM which is stored on disk. CUMFREQ will read this binary file from unit 8.

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------

CUMFREQ
                                                    1000000.         1    3   30
                100.      200.      500.
99999

--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

Figure 6-3 Example of CUMFREQ Input Stream

6.3.4 Output

This keyword produces a table, by receptor and level, giving the observed frequency of occurrence as well as the cumulative frequency of occurrence. The final column gives, by receptor, the average concentrations for the entire time period analyzed. See Figure 6-4 for a sample of the output.

In the analysis program CUMFREQ, the output is designated to unit 6.

6.3.5 Diagnostics

The error messages for CUMFREQ are as follows:

"NLEV OUT OF RANGE"	Indicates that the number of user-specified levels is < 0 or > 20.
"NR OUT OF RANGE"	Indicates that the number of user-specified receptors is < 1 or > 400.
"INPUT FILE TOO SHORT"	Indicates that a premature end-of-file was encountered in the binary concentration file.
"FIRST DATA LINE FORMAT ERROR"	Indicates that an error was found in the CUMFREQ input stream.

6.4 PEAK

6.4.1 Description

The analysis program PEAK is used to read a sequence of hourly concentrations. All non-overlapping n-hour averages which exceed a specified ambient air quality threshold (e.g., standard) are tabulated for each receptor. The output from PEAK presents a detailed breakdown of concentrations for each hour contained in the averaging period

```
    POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125


CUMFREQ


      HOURIN    DAYSIN    RFACT        NHR  NLEV  NR
          0.        0.  1000000.         1    3   30


  CUMULATIVE LEVELS:
            100.0     200.0     500.0
```

Figure 6-4 Example of CUMFREQ Output

```
  POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125

 CUMULATIVE FREQUENCIES OF     1-HOUR AVERAGES FOR    4. OBSERVATIONS

RECEPTOR    I   LEVEL   I  LEVEL   I  LEVEL   I  LEVEL    IAVG:# OBS= I
            I     100.0I     200.0I     500.0I **********I        4.0I
            +----------+----------+----------+----------+-----------+
     1      I    .7500 I    .2500 I    .0000 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I   1.0000 I   1.0000 I   1.0000 I   25.9879 I
            +----------+----------+----------+----------+-----------+
     2      I   1.0000 I    .0000 I    .0000 I    .0000 I     .0000 I
  CUM FREQ  I   1.0000 I   1.0000 I   1.0000 I   1.0000 I    1.8679 I
            +----------+----------+----------+----------+-----------+
     3      I    .7500 I    .2500 I    .0000 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I   1.0000 I   1.0000 I   1.0000 I   40.8769 I
            +----------+----------+----------+----------+-----------+
     4      I    .7500 I    .2500 I    .0000 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I   1.0000 I   1.0000 I   1.0000 I   32.9525 I
            +----------+----------+----------+----------+-----------+
     5      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I    .7500 I   1.0000 I   1.0000 I   73.4634 I
            +----------+----------+----------+----------+-----------+
     6      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I    .7500 I   1.0000 I   1.0000 I   63.3557 I
            +----------+----------+----------+----------+-----------+
     7      I    .7500 I    .2500 I    .0000 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I   1.0000 I   1.0000 I   1.0000 I   42.7870 I
            +----------+----------+----------+----------+-----------+
     8      I    .5000 I    .0000 I    .2500 I    .2500 I     .0000 I
  CUM FREQ  I    .5000 I    .5000 I    .7500 I   1.0000 I  202.2595 I
            +----------+----------+----------+----------+-----------+
     9      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I    .7500 I   1.0000 I   1.0000 I   96.2294 I
            +----------+----------+----------+----------+-----------+
    10      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I    .7500 I   1.0000 I   1.0000 I  108.5356 I
            +----------+----------+----------+----------+-----------+
    11      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I    .7500 I   1.0000 I   1.0000 I   92.1426 I
            +----------+----------+----------+----------+-----------+
    12      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I    .7500 I   1.0000 I   1.0000 I   94.3915 I
            +----------+----------+----------+----------+-----------+
    13      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I    .7500 I   1.0000 I   1.0000 I   88.4272 I
            +----------+----------+----------+----------+-----------+
    14      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .7500 I    .7500 I   1.0000 I   1.0000 I   77.9492 I
            +----------+----------+----------+----------+-----------+
    15      I    .5000 I    .2500 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .5000 I    .7500 I   1.0000 I   1.0000 I  108.6529 I
            +----------+----------+----------+----------+-----------+
    16      I    .5000 I    .2500 I    .2500 I    .0000 I     .0000 I
  CUM FREQ  I    .5000 I    .7500 I   1.0000 I   1.0000 I  114.8243 I
            +----------+----------+----------+----------+-----------+
```

Figure 6-4 (Continued)

```
    POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125

   CUMULATIVE FREQUENCIES OF     1-HOUR AVERAGES FOR    4. OBSERVATIONS

 RECEPTOR    I   LEVEL   I   LEVEL   I   LEVEL   I   LEVEL   IAVG:# OBS= I
             I     100.0I      200.0I      500.0I **********I        4.0I
             +----------+----------+----------+----------+-----------+
     17      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ   I    .7500 I    .7500 I   1.0000 I   1.0000 I  103.3214 I
             +----------+----------+----------+----------+-----------+
     18      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ   I    .7500 I    .7500 I   1.0000 I   1.0000 I  113.0639 I
             +----------+----------+----------+----------+-----------+
     19      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ   I    .7500 I    .7500 I   1.0000 I   1.0000 I   91.6941 I
             +----------+----------+----------+----------+-----------+
     20      I    .7500 I    .2500 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I    .7500 I   1.0000 I   1.0000 I   1.0000 I   48.6757 I
             +----------+----------+----------+----------+-----------+
     21      I   1.0000 I    .0000 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I   1.0000 I   1.0000 I   1.0000 I   1.0000 I   22.1803 I
             +----------+----------+----------+----------+-----------+
     22      I    .7500 I    .0000 I    .2500 I    .0000 I     .0000 I
  CUM FREQ   I    .7500 I    .7500 I   1.0000 I   1.0000 I   66.5591 I
             +----------+----------+----------+----------+-----------+
     23      I    .5000 I    .2500 I    .2500 I    .0000 I     .0000 I
  CUM FREQ   I    .5000 I    .7500 I   1.0000 I   1.0000 I  113.3561 I
             +----------+----------+----------+----------+-----------+
     24      I    .7500 I    .2500 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I    .7500 I   1.0000 I   1.0000 I   1.0000 I   49.5396 I
             +----------+----------+----------+----------+-----------+
     25      I   1.0000 I    .0000 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I   1.0000 I   1.0000 I   1.0000 I   1.0000 I     .0000 I
             +----------+----------+----------+----------+-----------+
     26      I   1.0000 I    .0000 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I   1.0000 I   1.0000 I   1.0000 I   1.0000 I     .0000 I
             +----------+----------+----------+----------+-----------+
     27      I   1.0000 I    .0000 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I   1.0000 I   1.0000 I   1.0000 I   1.0000 I     .0000 I
             +----------+----------+----------+----------+-----------+
     28      I   1.0000 I    .0000 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I   1.0000 I   1.0000 I   1.0000 I   1.0000 I     .0015 I
             +----------+----------+----------+----------+-----------+
     29      I   1.0000 I    .0000 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I   1.0000 I   1.0000 I   1.0000 I   1.0000 I     .0000 I
             +----------+----------+----------+----------+-----------+
     30      I   1.0000 I    .0000 I    .0000 I    .0000 I     .0000 I
  CUM FREQ   I   1.0000 I   1.0000 I   1.0000 I   1.0000 I     .0000 I
             +----------+----------+----------+----------+-----------+
```

Figure 6-4 (Continued)

along with the corresponding hourly weather conditions (wind direction wind speed, mixing depth and stability). A table of maximum n-hour concentrations and a table of threshold exceedances is also obtained.

Any threshold value (THR) greater than zero may be input. The program will, thus, provide information for any average concentrations equal to or exceeding the specified value. To limit output, the threshold should be chosen with care. A value which is low in relation to the averaged concentrations will result in massive output, since the concentration and meteorological parameters are printed for each hour in the averaged time period for each exceedance of the threshold. As a screening tool for the determination of an appropriate threshold value, the results from CUMFREQ can be used. The output from CUMFREQ which is run with a corresponding averaging period will present the frequency of concentrations at or above a specified level. In addition, the logical variable LPRINT in PEAK can be set to FALSE which will produce only a summary of case-by-case output.

The user may specify any hourly averaging period up to and including 24. If desired, it is possible to process only the beginning segment of the hourly concentration file by using the variables DAYSIN and HOURSIN. DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

$$(\text{hours processed}) = 24 * \text{DAYSIN} + \text{HOURSIN}$$

It should be noted that the first hour in the hourly concentration file is referenced as day one and hour one (see example in Section 6.2.1). If the averaging time does not divide evenly into the hours to be processed, the program will automatically complete the period by including the next available hours. If no following hours are found, the program will end at the last complete time period and ignore the remaining hours.

6.4.2 Input Stream

This keyword requires two data lines. The alphabetic characters in LPRINT and IUNITS must be left-justified. (See Figure 6-5.)

Line 1:

NHR (I5)	(Cols. 11-15):	Number of hours in the averaging period; must satisfy $1 \leq NHR \leq 24$ (if omitted or 0, NHR = 1 is assumed).
THR (F10.0)	(Cols. 16-25):	Threshold; must satisfy THR 0. Defaults to 0.
HOURSIN (F10.0)	(Cols. 26-35):	The number of hours to be read (if omitted or 0, the file is read from hour = 1 end-of-file). Defaults to 0.
DAYSIN (F10.0)	(Cols. 36-45):	The number of days to be read (if omitted or 0, the file is read from hour = 1 to EOF). Defaults to 0.
NH (I10)	(Cols. 46-55):	The number of hours represented by each record of the input binary file.

Line 2:

RFACT (F10.0)	(Cols. 11-20):	The factor to convert internal concentrations for printing. Default changes gm/m^3 to $\mu g/m^3$.
UNITS (L4)	(Cols. 21-28):	Units for labeling. Defaults to "µG/M**3" Left justify.

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------

PEAK
              1  250.
                              TRUE         30
99999

--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
```

Figure 6-5 Example of PEAK Input Stream

LPRINT (L10) (Cols. 31-40): Logical variable to control the amount of output. If it is 'TRUE', a detailed breakdown for threshold violations is obtained. If 'FALSE', a summary of violations is obtained. Default = TRUE. Left justify.

NR (I5) (Cols. 41-45): The number of receptors to be processed; must satisfy $1 \leq NR \leq 400$ or program aborts (no default value).

SCALE (F10.0) (Cols. 46-55): Scale factor for input concentrations. Defaults to 1.0.

6.4.3 Input Data

The input data for PEAK is composed of the sequential output from RTDM which is stored on disk. PEAK will read this binary file from unit 8.

6.4.4 Output

There are three forms of output:

- A detailed breakdown of concentrations, their averages, and weather conditions for each receptor where the n-hour average concentration exceeded the threshold.
- A tabulation of the maximum n-hour average concentrations with the day and hour of occurrence for each receptor. (Maximums are independent of the threshold level.)
- A tabulation of threshold exceedances of n-hour averages by receptor.

The tables of maximums and exceedances report predicted concentrations by receptor. These values are arranged in rows each containing 8 receptors in order of their input into RTDM. The first row lists receptors 1-8, the second row lists receptors 9-16, the third row lists receptors 17-24, etc., up to the last receptor. See Figure 6-6 for a sample of the output.

In the analysis program PEAK, the output is designated to unit 6.

6.4.5 Diagnostics

The error messages for PEAK are as follows:

"NR IS OUT OF RANGE"	Indicates that the number of receptors is < 1 or > 400.
"NHR IS OUT OF RANGE"	Indicates that the user-specified number of averaging hours is > 24 or < 1.
"THR IS OUT OF BOUNDS"	Indicates that the user-specified threshold level is < 0.
"ILLEGAL DATA LINE"	Indicates that an error was found in the PEAK input stream.
"UNEXPECTED END OF FILE"	Indicates that a premature end-of-file was found in the binary concentration file.

6.5 AVERAGES

6.5.1 Description

The analytical tool AVERAGES is applied to a binary RTDM concentration file and results in a binary concentration file of running averages for a user-specified hourly averaging period (maximum of 24 hours). The maximum number of receptors processed by AVERAGES is 400. The resulting file can be processed by the other post-processing programs, such as CUMFREQ, TOPVAL, and PEAK.

```
    POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125


PEAK


         NHR       THR     HOURIN    DAYSIN       NH

           1      250.        0.        0.         1

          RFACT   UNITS        LPRINT   NR  SCALE

         1000000.                   T   30         1.
```

Figure 6-6 Example of PEAK Output

```
        POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  2  AT RECEPTOR    8
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        554.8120               2140  190    4   13
 MEAN        554.8120

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR    5
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        279.1396                773  210    2    1
 MEAN        279.1396

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR    6
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        253.2820                773  210    2    1
 MEAN        253.2820

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR    8
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        252.9272                773  210    2    1
 MEAN        252.9272

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR    9
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        345.8530                773  210    2    1
 MEAN        345.8530

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   10
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        359.9045                773  210    2    1
 MEAN        359.9045

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   11
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        322.7112                773  210    2    1
 MEAN        322.7112

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   12
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        356.3389                773  210    2    1
 MEAN        356.3389

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   13
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        337.1736                773  210    2    1
 MEAN        337.1736

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   14
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD         TOTAL                MIX  DIR  STAB SPD
    1        303.9636                773  210    2    1
 MEAN        303.9636
```

Figure 6-6 (cont.)

```
         POST-PROCESSING ANALYSIS PROGRAM    VERSION 2.30     LEVEL 851125

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  15
 **** CONCENTRATIONS (uG/M**3 )           WEATHER
 RECORD       TOTAL                  MIX  DIR  STAB SPD
    1       314.2187                 773  210    2    1
 MEAN       314.2187

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  16
 **** CONCENTRATIONS (uG/M**3 )           WEATHER
 RECORD       TOTAL                  MIX  DIR  STAB SPD
    1       349.0750                 773  210    2    1
 MEAN       349.0750

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  17
 **** CONCENTRATIONS (uG/M**3 )           WEATHER
 RECORD       TOTAL                  MIX  DIR  STAB SPD
    1       329.5166                 773  210    2    1
 MEAN       329.5166

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  18
 **** CONCENTRATIONS (uG/M**3 )           WEATHER
 RECORD       TOTAL                  MIX  DIR  STAB SPD
    1       366.8562                 773  210    2    1
 MEAN       366.8562

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  19
 **** CONCENTRATIONS (uG/M**3 )           WEATHER
 RECORD       TOTAL                  MIX  DIR  STAB SPD
    1       303.7729                 773  210    2    1
 MEAN       303.7729

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  22
 **** CONCENTRATIONS (uG/M**3 )           WEATHER
 RECORD       TOTAL                  MIX  DIR  STAB SPD
    1       265.0759                 773  210    2    1
 MEAN       265.0759

   250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  23
 **** CONCENTRATIONS (uG/M**3 )           WEATHER
 RECORD       TOTAL                  MIX  DIR  STAB SPD
    1       346.9060                 773  210    2    1
 MEAN       346.9060
```

Figure 6-6 (Continued)

```
     POST-PROCESSING ANALYSIS PROGRAM      VERSION 2.30       LEVEL 851125

TOTAL MAXIMUM CONCENTRATIONS (uG/M**3 ) FOR     4 ( 1-HOUR) AVERAGING PERIOD(S

 RECEP +     1    +     2    +     3    +     4    +     5    +     6    +     7    +     8
-------+----------+----------+----------+----------+----------+----------+----------+-------
  CONC ! 103.948!    7.471! 163.498! 131.761! 279.140! 253.282! 171.137! 554.81
DAY/HR !    1    4!   1    4!   1    4!   1    4!   1    4!   1    4!   1    4!   1

 RECEP +     9    +    10    +    11    +    12    +    13    +    14    +    15    +    16
-------+----------+----------+----------+----------+----------+----------+----------+-------
  CONC ! 345.853! 359.905! 322.711! 356.339! 337.174! 303.964! 314.219! 349.07
DAY/HR !    1    4!   1    4!   1    4!   1    4!   1    4!   1    4!   1    4!   1

 RECEP +    17    +    18    +    19    +    20    +    21    +    22    +    23    +    24
-------+----------+----------+----------+----------+----------+----------+----------+-------
  CONC ! 329.517! 366.856! 303.773! 187.782!   88.721! 265.076! 346.906! 193.39
DAY/HR !    1    4!   1    4!   1    4!   1    4!   1    4!   1    4!   1    4!   1

 RECEP +    25    +    26    +    27    +    28    +    29    +    30    +
-------+----------+----------+----------+----------+----------+----------+
  CONC !      .000!     .000!     .000!     .003!     .000!     .000!
DAY/HR !    0    0!   0    0!   1    3!   1    4!   0    0!   0    0!




     POST-PROCESSING ANALYSIS PROGRAM      VERSION 2.30       LEVEL 851125

     NUMBER OF  1-HOUR AVERAGES ABOVE   250.0000 uG/M**3  FOR      4 HOURS

   RECEPTORS:
   -------+---------+---------+---------+---------+---------+---------+---------+-------
     1-  8!      0  !      0  !      0  !      0  !      1  !      1  !      0  !      2
   -------!---------!---------!---------!---------!---------!---------!---------!-------
     9- 16!      1  !      1  !      1  !      1  !      1  !      1  !      1  !      1
   -------!---------!---------!---------!---------!---------!---------!---------!-------
    17- 24!      1  !      1  !      1  !      0  !      0  !      1  !      1  !      0
   -------!---------!---------!---------!---------!---------!---------!---------!-------
    25- 30!      0  !      0  !      0  !      0  !      0  !      0  !
   -------!---------!---------!---------!---------!---------!---------!
```

Figure 6-6 (Continued)

6.5.2 Input Stream

For AVERAGES:

This keyword requires one data line.

Line 1:

N (I5)	(Cols. 1-5):	The number of hours to be averaged. Maximum = 24.
NRECP (I5)	(Cols. 6-10):	The number of receptors to be processed. Maximum = 400.

Ordinarily N will not equal 1, since the other postprocessors can be run directly for one-hour averages. See Figure 6-7 for example input.

6.5.3 Input Data

Input data for AVERAGES is composed of the sequential output of RTDM which is stored on disk. AVERAGES will read this binary file from unit 8.

6.5.4 Output

A short file of printed output is obtained from the program AVERAGES which consists of the input parameters and the number of hours processed. The results are stored in a binary concentration file on disk. The printed output is designated to a specific unit (6).

6.5.5 Processing of AVERAGES Results

PEAK, TOPVAL, and CUMFREQ should be used in the 1-hour averaging period mode when processing AVERAGES results, and the number of hours per record should be set to 1. The AVERAGES routine creates running average concentrations for the specified averaging period as single

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------

AVERAGE
    3   30
99999

--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
```

Figure 6-7 Example of AVERAGE Input Stream

entries. Thus, a request for 1-hour averaged values by the other postprocessing programs will result in the proper retrieval of data created by AVERAGES. The variables to specify partial files of data (DAYSIN and HOURSIN) should also be manipulated as if each averaging period used by AVERAGES is 1 hour in length.

The output from the postprocessing programs will indicate the beginning rather than the last hour of each running average concentration. In the detailed output from PEAK, the meteorological data and concentration levels listed for each threshold violation will refer to the conditions which had occurred during the last hour of the averaging period, although the hour listed is the first hour of the averaging period.

6.5.6 Diagnostics

The error messages associated with AVERAGES are as follows:

"ILLEGAL CARD FORMAT FOR DATA"	Indicates that an error was found in the AVERAGES input stream.
"NUMBER OF HOURS TOO SMALL"	Indicates that the user-specified averaging period is < 1.
"UNEXPECTED END OF FILE"	Indicates that a premature end-of-file was found in the binary concentration file.

6.6 SEQADD

6.6.1 Description

The SEQADD keyword is used to scale concentrations from a single concentration file, or to add the concentrations from up to 5 input files to create a new file. Individual user-specified scale factors are applied to the hourly concentrations from each file before the results are added. The maximum member of receptors that can be processed by SEQADD is 400. The newly created file can be used as input to other postprocessing keywrods, such as CUMFREQ, TOPVAL, PEAK, and AVERAGES.

6.6.2 Input Stream

The card image input required for the SEQADD after the "SEQADD" keyword is as follows (see Figure 6-8 for an example):

Line 1 (free format):

N:	The number of concentration files to be scaled and added.
NRECP:	The number of receptors in each fiel (NOTE: each file must represent the same receptors for the same time period).

Line 2 (free format):

SCALE(I), I=1,N:	Scale factors for each respective file. Concentrations are multiplied by the scale factor for that file before being added.

6.6.3 Input Data

The input concentration data for SEQADD is comprised of from 1 to 5 output files from RTDM. These files are read via channels 11 through 15.

6.6.4 Output

The input specifications to SEQADD are echoed in printed output. A concentration file that results from scaling and adding the input concentration data is written to unit 10.

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------


SEQADD
2  30
1.0  1.0
99999


--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
```

Figure 6-8 Example of SEQADD Input Stream

6.6.5 Processing of SEQADD Results

The new concentration file that results from the SEQADD run can be used as input to any other ANALYSIS keyword, including SEQADD itself. The file structure is the same as that of a concentration file produced directly by RTDM.

6.6.6 Diagnostics

The possible error messages associated with SEQADD are as follows:

"FORMAT ERROR IN READING NUMBER OF FILES, RECEPTOR"	Indicates non-integer data found on the first input line.
"FORMAT ERROR IN READING SCALE FACTORS"	A non-numeric character was encountered on the second input line.
"# OF INPUT FILES NOT BETWEEN 1 and 5"	Correct the first value on the first input line.
"# OF RECEPTORS NOT BETWEEN 1 AND 400:	Correct the second value on the first input line.

6.7 Computer Job Control Considerations

For ANALYSIS, the input run stream file is associated with unit 5, and the output with unit 6. For keywords PEAK, TOPVAL, and CUMFREQ, unit 8 is associated with the disk file of concentrations to be read (disk filename is "CONCFILE"). For keyword AVERAGES, unit 8 is associated with the concentration file to be read ("CONCFILE1") and unit 9 is associated with the concentration file to be written ("CONCFILE2")

7. SAMPLE RTDM RUN

A sample run of RTDM that can be used to determine whether the model has been properly installed on a user's computer system is shown in this section. The meteorological input file consists of 2 cases for each of 6 stability classes, and is shown in Figure 7-1. The input run stream chosen for this example is shown in Figure 7-2. Constant stack emissions are used, so an hourly emissions input file is not read by RTDM in this example. The RTDM output (case-study mode) is shown in Figure 7-3. Examples of postprocessor (ANALYSIS) runs consistent with the sample RTDM run are shown in Figure 7-4, using keywords TOPVAL, CUMFREQ, and PEAK.

```
7636524 220.  1.0    3000. 1.    68.   0.22  0.20  0.0   0.0   0.1    .09  2.0
7636604 220.  3.0    1000. 1.    68.   0.22  0.20  0.0   0.0   0.1   -.09  6.0
7636609 220.  2.0    3000. 2.    68.   0.16  0.12  0.0   0.0   0.12   .11  4.0
7636612 220.  4.0     700. 2.    68.   0.16  0.12  0.0   0.0   0.12  -.11  7.0
7636614 220.  2.0    3000. 3.    68.   0.11  0.08  0.0   0.0   0.15   .12  4.0
7636619 220.  7.0     550. 3.    68.   0.11  0.08  0.0   0.0   0.15  -.12  14.0
7700105 220.  3.0    1000. 4.    68.   0.08  0.06  0.0   0.0   0.20   .14  6.0
7700111 220.  15.     450. 4.    68.   0.08  0.06  0.0   0.0   0.20  -.14  30.0
7700113 220.  2.0    3000. 5.    68.   0.06  0.03  0.02  0.02  0.30   .20  5.0
7700116 220.  4.0     700. 5.    68.   0.06  0.03  0.003 0.005 0.30  -.20  10.0
7700119 220.  2.5    2000. 6.    68.   0.04  0.016 0.006 0.02  0.40  0.30  7.0
7700122 220.  4.0     650. 6.    68.   0.04  0.016 0.04  0.006 0.40  -.30  12.0
```

Figure 7-1   RTDM Input Meteorology Used for Sample Run

```
PARAMETERS
PR003    1.
PR004    10.0              0.      0.
PR022    1.
PR018    1.
PR019    1.
PR020    1.      .17
PR021    1.
PR023    1.
         22.5    22.5    22.5    22.5    22.5    22.5
PR025    1.
99999
STACKS
600.      800.       765.       SO2
STK1      121.92     5.0        20.0       370.       1000.
99999
POINTS
          603.16     801.61     2782.      WEST MT.
          602.75     799.90     2430.      BRUSH MT.
          603.46     799.41     2520.      WALKER MT.
          600.53     800.63     1100.
          600.64     800.76     1200.
          600.80     800.96     1300.
          600.85     801.01     1400.
          600.96     801.14     1500.
          601.09     801.30     1600.
          601.31     801.56     1700.
          601.43     801.70     1800.
          601.61     801.92     1900.
          601.84     802.19     2000.
          603.59     804.27     2100.
          603.70     804.40     2200.
          603.89     804.63     2300.
          603.93     804.68     2400.
          603.96     804.72     2500.
          603.98     804.74     2600.
          603.99     804.76     2700.
          604.00     804.77     2800.
          604.03     804.80     2900.
          604.04     804.82     3000.      TUMBLEDOWN MT.
          603.35     793.70     1631.      BUNKER MT.
          598.10     798.23     2440.      RECORD HILL
          596.53     799.26     2440.      OLD TURK MT.
99999
TERRAIN
1100.     100.
010       4.46   4.78   5.01   7.00   7.38   -999.

020       1.50   3.35   3.45   3.75   3.85   3.95   4.05   4.20   4.60   4.70
          4.80   -999.
030       1.40   1.50   1.65   3.00   3.10   3.16   3.24   3.31   3.50   -999.

040       1.28   1.40   1.46   1.53   1.61   1.74   1.88   1.98   2.72   -999.

050       1.15   1.30   1.39   1.49   1.60   1.69   1.75   1.82   1.94   2.06
          2.13   2.22   2.34   -999.
060       1.18   1.29   1.40   1.48   1.58   1.69   1.80   1.94   2.10   2.24
```

Figure 7-2 RTDM Input Run Stream Used for Sample Run

```
           2.58    -999.
070        1.25     1.47    1.60    1.72    1.87    2.03    2.20    2.32    2.47    -999.

080        1.41     1.58    1.70    1.87    2.00    2.12    2.24    2.38    2.44    2.49
           2.59    -999.
090        1.64     1.75    1.88    1.99    2.09    2.20    2.39    2.59    2.76    2.94
           3.08    -999.
100        1.99     2.09    2.18    2.30    2.52    2.59    2.66    2.71    2.81    2.95
           3.09     3.18    3.29   -999.
110        2.02     2.28    2.40    2.52    2.63    2.72    3.00    3.19    3.55    -999.

120        2.21     2.41    2.52    2.63    5.75    5.90    6.01    6.18    6.30    6.50
           6.73     6.85    7.07   -999.
130        2.75     5.47    5.62    5.92    6.01    6.70    6.90    7.37    7.48    7.79
          -999.
140        1.22     1.29    6.70    6.80    6.90    7.00   -999.

150        1.11     1.19    1.24    1.29    1.32   -999.

160        1.08     1.15    1.21    1.28    1.38    1.42    5.13    5.32    5.51    -999.

170        1.01     1.12    1.23    1.34    1.48    1.53    4.98   -999.

180        0.81     1.04    1.18    1.38    1.51    1.66    1.82    2.10    2.23    2.31
           4.79     4.92    5.05   -999.
190        0.79     0.90    1.07    1.23    1.37    1.50    1.71    1.81    1.91    2.01
          -999.
200        0.68     0.82    1.00    1.16    1.30    1.50    1.68    1.95    2.52    -999.

210        0.71     0.83    1.03    1.20    1.43    1.58    1.81    2.15    2.30    2.52
           2.62     2.73   -999.
220        0.82     0.99    1.25    1.32    1.49    1.70    2.04    2.22    2.50    2.86
           5.58     5.75    6.05    6.11    6.16    6.19    6.21    6.23    6.27    6.29
230        1.05     1.21    1.48    1.61    2.02    2.17    2.28    2.42    2.54    2.67
           2.84     3.01    3.17    3.21    3.28    3.32    7.42    7.49   -999.
240        1.05     1.20    1.41    1.61    1.78    1.90    2.04    2.16    2.38    2.52
           2.68     2.80    2.91    3.14    3.31    3.39    3.45   -999.
250        1.00     1.23    1.31    1.40    1.56    1.70    1.86    1.97    2.08    2.17
           2.30     2.45    2.57    2.80   -999.
260        1.00     1.11    1.27    1.36    1.49    1.60    1.78    2.09    2.27    2.45
           2.56     2.63    2.73    2.84   -999.
270        1.03     1.16    1.28    1.38    1.48    1.53    1.66    1.73    1.88    2.09
           2.26     2.49    2.61   -999.
280        1.09     1.22    1.34    1.43    1.54    1.63    1.71    1.76    1.82    1.89
           1.97     2.10    3.50    3.58    3.70   -999.
290        1.16     1.28    1.43    1.57    1.67    1.76    1.83    1.98    2.13    3.26
           3.34     3.50    3.65    3.79    3.90    4.05   -999.
300        1.28     1.41    1.60    1.74    1.89    2.10    2.90    3.01    3.16    3.24
           3.33     3.96    4.03    4.17   -999.
310        1.46     1.60    1.75    1.90    2.90    3.04    3.42    3.59    3.75    3.90
           3.98     4.08    4.20    8.25    8.35   -999.
320        1.65     1.85    2.00    3.12    3.36    3.49    4.05    4.20    4.42    8.55
           8.65    -999.
330        2.18     2.97    4.42    4.61    4.78   -999.

340        6.23     6.42    6.58   -999.
```

Figure 7-2 (cont.)

```
350         4.69   4.90   -999.

360         4.31   6.80   -999.

99999
EXECUTE
        220.   5.0    3000. 4.    68.    0.08   0.06   0.0    0.0    0.20   0.14  10.
ENDJOB
```

Figure 7-2 (cont.)

```
ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                                PAGE   1

       MODEL PARAMETERS:

       PR001:  HORIZONTAL SCALE IS 1000.000 METERS PER USER UNIT

       PR002:  VERTICAL SCALE IS      .305 METERS PER USER UNIT

       PR003:  WIND SPEED SCALE IS    1.000 M/SEC PER USER UNIT

       PR004:  ANEMOMETER #1 HEIGHT ABOVE ZA (USED FOR PLUME RISE) IS  10.0 M
               IF AVAILABLE, ANEMOMETER #2 HEIGHT ABOVE ZA (USED FOR PLUME DILUTION) IS    .0 M
               DILUTION WIND SPEED OPTION IS 0       (IF 0, ONE WIND SPEED--AT STACK HEIGHT--IS USED FOR PLUME RISE AND DILUTION
               IF 1, WIND SPEED AT LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE AND TO PLUME HEIGHT FOR DILUTION
               IF 2, WIND SPEED AT LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE,
               AND THE SPEED AT LEVEL #2 IS EXTRAPOLATED TO PLUME HEIGHT FOR DILUTION)
               ZA (HEIGHT IN METERS ABOVE STACK BASE ELEVATION WHERE THE WIND SPEED PROFILE IS ASSUMED TO ORIGINATE) =      .000

       PR005:  DEFAULT WIND SPEED PROFILE EXPONENTS AS A FUNCTION OF STABILITY CLASS (1-6, RESPECTIVELY):
                         .0900   .1100   .1200   .1400   .2000   .3000

       PR006:  DISPERSION COEFFICIENTS ARE BRIGGS RURAL/ASME-1979 (UNLESS REPLACED BY ON-SITE TURBULENCE DATA).

       PR009:  PARTIAL PLUME PENETRATION OF MIXING LIDS IS NOT BEING USED.

       PR010:  BUOYANCY-ENHANCED PLUME DISPERSION IS USED; PARAMETER ALPHA IS    3.162

       PR011:  UNLIMITED MIXING HEIGHT USED FOR STABLE CONDITIONS

       PR012:  TRANSITIONAL PLUME RISE IS USED.

       PR013:  PLUME PATH COEFFICIENTS FOR STABILITY CLASSES 1-6:   .500  .500  .500  .500  .500  .500

       PR014:  DEFAULT VERTICAL POTENTIAL TEMPERATURE GRADIENTS USED FOR STABLE PLUME RISE (CLASSES 5 & 6):   .0200  .0350

       PR015:  STACK-TIP DOWNWASH IS NOT USED.

       PR016:  Y-COMPONENT TURBULENCE INTENSITY VALUES ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Y.

       PR017:  Z-COMPONENT TURBULENCE INTENSITY VALUES ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Z.

       PR018:  HOURLY VERTICAL POTENTIAL TEMPERATURE GRADIENTS ARE PROVIDED FOR COMPUTING STABLE PLUME RISE.

       PR019:  HOURLY VERTICAL POTENTIAL TEMPERATURE GRADIENTS ARE PROVIDED FOR COMPUTING HCRIT.

       PR020:  WIND DIRECTION SHEAR IS USED IN COMPUTATION OF SIGMA-Y; COEFFICIENT =    .17

       PR021:  HOURLY VALUES OF WIND SPEED PROFILE EXPONENT ARE PROVIDED.

       PR022:  PARTIAL REFLECTION ALGORITHM IS BEING USED; KEYWORD TERRAIN MUST BE USED TO READ IN TERRAIN.

       PR023:  OFF-CENTERLINE CONCENTRATIONS ARE COMPUTED FOR ALL STABILITIES; NO SECTOR AVERAGING IS USED.

       PR024:  HOURLY EMISSIONS DATA ARE NOT AVAILABLE; CONSTANT VALUES SPECIFIED IN THE STACKS SECTION ARE USED.

       PR025:  DETAILED INFORMATION ABOUT EACH CASE WILL BE PRINTED.
```

Figure 7-3   RTDM Output from Sample Run

```
ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                    PAGE   2

     MODELED STACK PARAMETERS:


     X,Y COORDINATE OF ALL SOURCES (USER UNITS) IS (    600.00 ,      800.00 )  OR  ( 600000.00 ,  800000.00) METERS
     BASE HEIGHT OF ALL SOURCES (USER UNITS) IS    765.000 OR     233.172 METERS
     POLLUTANT IS SO2


     CODE NAME   STACK HT (M)   DIAMETER (M)   EXIT VEL (M/SEC)  STACK TEMP (K)  EMISSION RATE (G/SEC)

    1   STK1       121.920         5.000            20.000          370.000            1000.000
```

Figure 7-3 (Page 2 of 14)

```
ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                                   PAGE   3

        RECEPTOR POINT INFORMATION (ALL COORDINATES IN USER UNITS):

        RECEPTOR     X-COORD     Y-COORD     HEIGHT      NAME

            1        603.16      801.61     2782.00** WEST MT.
            2        602.75      799.90     2430.00** BRUSH MT.
            3        603.46      799.41     2520.00** WALKER MT.
            4        600.53      800.63     1100.00
            5        600.64      800.76     1200.00**
            6        600.80      800.96     1300.00**
            7        600.85      801.01     1400.00**
            8        600.96      801.14     1500.00**
            9        601.09      801.30     1600.00**
           10        601.31      801.56     1700.00**
           11        601.43      801.70     1800.00**
           12        601.61      801.92     1900.00**
           13        601.84      802.19     2000.00**
           14        603.59      804.27     2100.00**
           15        603.70      804.40     2200.00**
           16        603.89      804.63     2300.00**
           17        603.93      804.68     2400.00**
           18        603.96      804.72     2500.00**
           19        603.98      804.74     2600.00**
           20        603.99      804.76     2700.00**
           21        604.00      804.77     2800.00**
           22        604.03      804.80     2900.00**
           23        604.04      804.82     3000.00** TUMBLEDOWN MT.
           24        603.35      793.70     1631.00** BUNKER MT.
           25        598.10      798.23     2440.00** RECORD HILL
           26        596.53      799.26     2440.00** OLD TURK MT.

** THIS RECEPTOR IS HIGHER IN ELEVATION THAN THAT OF THE LOWEST STACK TOP.
   SPECIAL ALGORITHMS CONCERNING PLUME IMPINGEMENT AND REFLECTION MAY INFLENCE CONCENTRATIONS MODELED AT THIS RECEPTOR.
```

Figure 7-3 (Page 3 of 14)

```
ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                    PAGE   4

     TERRAIN INFORMATION:

           TABLE OF DISTANCES (KM) FROM THE SOURCE TO ELEVATION CONTOURS AS A FUNCTION OF WIND DIRECTION

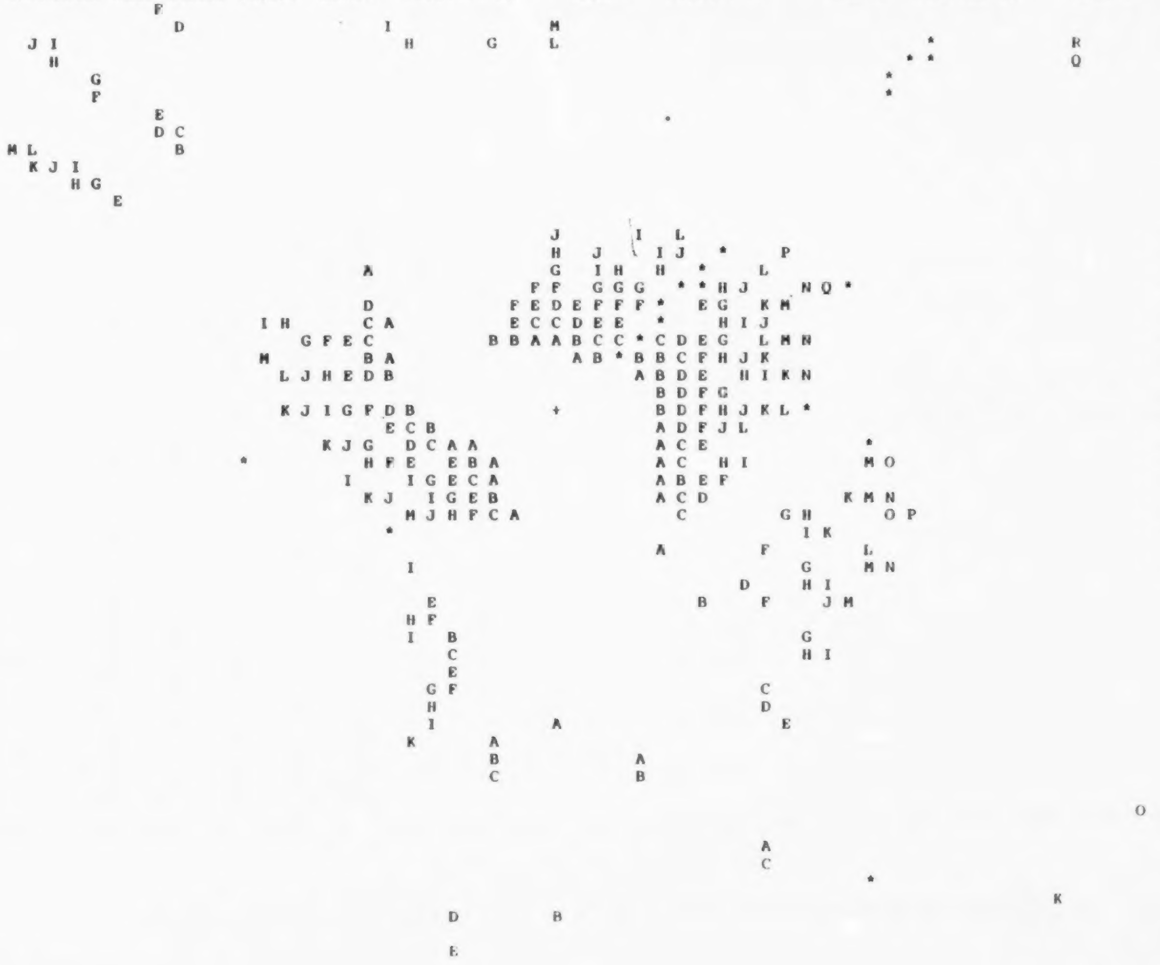
                                                      ELEVATION IN USER UNITS:

WIND DIR.   1100. 1200. 1300. 1400. 1500. 1600. 1700. 1800. 1900. 2000. 2100. 2200. 2300. 2400. 2500. 2600. 2700. 2800. 2900. 3000.

    10       4.46  4.78  5.01  7.00  7.38
    20       1.50  3.35  3.45  3.75  3.85  3.95  4.05  4.20  4.60  4.70  4.80
    30       1.40  1.50  1.65  3.00  3.10  3.16  3.24  3.31  3.50
    40       1.28  1.40  1.46  1.53  1.61  1.74  1.88  1.98  2.72
    50       1.15  1.30  1.39  1.49  1.60  1.69  1.75  1.82  1.94  2.06  2.13  2.22  2.34
    60       1.18  1.29  1.40  1.48  1.58  1.69  1.80  1.94  2.10  2.24  2.58
    70       1.25  1.47  1.60  1.72  1.87  2.03  2.20  2.32  2.47
    80       1.41  1.58  1.70  1.87  2.00  2.12  2.24  2.38  2.44  2.49  2.59
    90       1.64  1.75  1.88  1.99  2.09  2.20  2.39  2.59  2.76  2.94  3.08
   100       1.99  2.09  2.18  2.30  2.52  2.59  2.66  2.71  2.81  2.95  3.09  3.18  3.29
   110       2.02  2.28  2.40  2.52  2.63  2.72  3.00  3.19  3.55
   120       2.21  2.41  2.52  2.63  5.75  5.90  6.01  6.18  6.30  6.50  6.73  6.85  7.07
   130       2.75  5.47  5.62  5.92  6.01  6.70  6.90  7.37  7.48  7.79
   140       1.22  1.29  6.70  6.80  6.90  7.00
   150       1.11  1.19  1.24  1.29  1.32
   160       1.08  1.15  1.21  1.28  1.38  1.42  5.13  5.32  5.51
   170       1.01  1.12  1.23  1.34  1.48  1.53  4.98
   180        .81  1.04  1.18  1.38  1.51  1.66  1.82  2.10  2.23  2.31  4.79  4.92  5.05
   190        .79   .90  1.07  1.23  1.37  1.50  1.71  1.81  1.91  2.01
   200        .68   .82  1.00  1.16  1.30  1.50  1.68  1.95  2.52
   210        .71   .83  1.03  1.20  1.43  1.58  1.81  2.15  2.30  2.52  2.62  2.73
   220        .82   .99  1.25  1.32  1.49  1.70  2.04  2.22  2.50  2.86  5.58  5.75  6.05  6.11  6.16  6.19  6.21  6.23  6.27  6.29
   230       1.05  1.21  1.48  1.61  2.02  2.17  2.28  2.42  2.54  2.67  2.84  3.01  3.17  3.21  3.28  3.32  7.42  7.49
   240       1.05  1.20  1.41  1.61  1.78  1.90  2.04  2.16  2.38  2.52  2.68  2.80  2.91  3.14  3.31  3.39  3.45
   250       1.00  1.23  1.31  1.40  1.56  1.70  1.86  1.97  2.08  2.17  2.30  2.45  2.57  2.80
   260       1.00  1.11  1.27  1.36  1.49  1.60  1.78  2.09  2.27  2.45  2.56  2.63  2.73  2.84
   270       1.03  1.16  1.28  1.38  1.48  1.53  1.66  1.73  1.88  2.09  2.26  2.49  2.61
   280       1.09  1.22  1.34  1.43  1.54  1.63  1.71  1.76  1.82  1.89  1.97  2.10  3.50  3.58  3.70
   290       1.16  1.28  1.43  1.57  1.67  1.76  1.83  1.98  2.13  3.26  3.34  3.50  3.65  3.79  3.90  4.05
   300       1.28  1.41  1.60  1.74  1.89  2.10  2.90  3.01  3.16  3.24  3.33  3.96  4.03  4.17
   310       1.46  1.60  1.75  1.90  2.90  3.04  3.42  3.59  3.75  3.90  3.98  4.08  4.20  8.25  8.35
   320       1.65  1.85  2.00  3.12  3.36  3.49  4.05  4.20  4.42  8.55  8.65
   330       2.18  2.97  4.42  4.61  4.78
   340       6.23  6.42  6.58
   350       4.69  4.90
   360       4.31  6.80
```

Figure 7-3 (Page 4 of 14)

MAP OF USER-SPECIFIED TERRAIN: LETTERS (SOME OVERWRITTEN) DENOTE ELEVATIONS (SEE TABLE); "+" = SOURCE; "*" = A RECEPTOR POINT
DISTANCES FROM SOURCE (0,0): XMIN = -6122.79 M, XMAX = 6396.47 M, YMIN = -7267.88 M, YMAX = 5362.32 M



CONTOUR
CODES

A	1100.00
B	1200.00
C	1300.00
D	1400.00
E	1500.00
F	1600.00
G	1700.00
H	1800.00
I	1900.00
J	2000.00
K	2100.00
L	2200.00
M	2300.00
N	2400.00
O	2500.00
P	2600.00
Q	2700.00
R	2800.00
S	2900.00
T	3000.00

Figure 7-3 (Page 5 of 14)

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ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                                              PAGE   6

THE CODE FOR MISSING DATA IS PRESENTED AS FOLLOWS:
  A "1" IS INCLUDED IF WIND DIRECTION IS MISSING,
  A "2" IS INCLUDED IF WIND SPEED IS MISSING,
  A "3" IS INCLUDED IF MIXING HEIGHT IS MISSING,
  A "4" IS INCLUDED IF STABILITY CLASS IS MISSING,
  A "5" IS INCLUDED IF AMBIENT TEMPERATURE IS MISSING.
  IF THERE IS MISSING DATA FOR ANY OF THESE PARAMETERS, THE PREVIOUS GOOD VALUE IS USED.
  IF THERE IS MISSING DATA FOR OPTIONAL PARAMETERS, THE DEFAULT VALUE (OBTAINED FROM THE STABILITY CLASS) IS USED.


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CASE-HOUR #    1          YEAR, DAY, HOUR: 76 365 24
               WIND      MIXING                  AIR      TURB.      TURB.      VPTG,       VPTG,      DELTA       WSPD        WIND
   WIND      SPEED #1    HEIGHT    STABILITY    TEMP    INTENSITY  INTENSITY    PLUME       HCRIT      THETA      PROFILE    SPEED #2
 DIRECTION   (M/SEC)      (M)        CLASS       (K)       (Y)        (Z)     (DEG K/M)  (DEG K/M)   (DEG/M)    EXPONENT    (M/SEC)

   220.        1.00      3000.         1       293.15    .2200*     .2000*      .0000       .0000      .1000       .0900       2.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =       .00 M
UTOP =  1.25 M/SEC,    FLUX =     254.59 M**4/S**3,  FINAL RISE =  858.18 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00


                        HT                                                                                     CONVENTIONAL REFLECTION
                       ABOVE PLUME HT  PLUME HT             SIGMA-Y                    SIGMA-Z          HORIZ.   VERTICAL    VERTICAL          CHI
                       STACK  BEFORE  CORRECTED                                                         DIST.      DIST.       DIST.
REC    X       Y       BASE  TERRAIN  BY TERRAIN   AMBIENT BUOY SHEAR  TOTAL  AMBIENT BUOY   TOTAL  FACTOR     FACTOR      FACTOR            (UG/
 #   (KM)    (KM)      (M)     (M)       (M)         (M)    (M)   (M)    (M)     (M)    (M)     (M)   (1/M)      (1/M)       (1/M)       R   M**3)

  1  3.26   -1.39   615.    980.10     672.71      623.6 271.4  831. 1073.9   652.9 271.4   707.1 .00016   .71766E-03  .71766E-03 1.27    93
  2  1.69   -2.17   507.    980.10     726.36      344.1 271.4  430.  614.3   338.2 271.4   433.6 .00000   .45240E-03  .92340E-03 1.00     0
  4   .82     .00   102.    833.12     782.06      174.1 224.9  174.  333.2   164.6 224.9   278.7 .00120   .55868E-04  .14313E-02 1.00    53.
  5   .99     .00   133.    928.10     861.81      208.5 254.9  238.  406.1   198.7 254.9   323.2 .00098   .70586E-04  .12343E-02 1.00    55.
  6  1.25     .00   163.    980.10     898.57      259.2 271.4  318.  492.0   249.9 271.4   368.9 .00081   .11139E-03  .10813E-02 1.00    72.
  7  1.32     .00   194.    980.10     883.33      273.0 271.4  336.  511.0   264.0 271.4   378.6 .00078   .13863E-03  .10536E-02 1.00    86.
  8  1.49     .00   224.    980.10     868.09      305.9 271.4  379.  557.8   298.0 271.4   403.1 .00072   .19472E-03  .98972E-03 1.00   111.
  9  1.70     .00   255.    980.10     852.85      345.1 271.4  432.  615.9   339.3 271.4   434.5 .00065   .26750E-03  .91859E-03 1.00   138.
 10  2.04     .00   285.    980.10     837.61      408.5 271.4  519.  713.8   407.4 271.4   489.5 .00056   .37709E-03  .81727E-03 1.00   168.
 11  2.22     .00   315.    980.10     822.37      442.1 271.4  566.  767.4   444.3 271.4   520.6 .00052   .44014E-03  .77152E-03 1.01   183.
 12  2.51     .00   346.    980.10     807.13      492.9 271.4  638.  850.6   501.1 271.4   569.9 .00047   .51356E-03  .71269E-03 1.02   192.
 13  2.86     .00   376.    980.10     791.89      554.9 271.4  728.  954.9   572.1 271.4   633.2 .00042   .57645E-03  .66065E-03 1.05   192.
 14  5.58    -.01   407.    980.10     776.65      983.3 271.4 1420. 1748.6  1115.7 271.4  1148.3 .00023   .55289E-03  .55289E-03 1.59   101.
 15  5.75    -.01   437.    980.10     761.41     1007.8 271.4 1464. 1797.6  1149.8 271.4  1181.3 .00022   .54890E-03  .54887E-03 1.63    97.
 16  6.05     .00   468.    980.10     746.17     1050.2 271.4 1539. 1883.2  1209.4 271.4  1239.5 .00021   .53741E-03  .53741E-03 1.67    91.
 17  6.11     .00   498.    980.10     730.93     1059.2 271.4 1556. 1901.6  1222.2 271.4  1252.0 .00021   .53788E-03  .53784E-03 1.69    90.
 18  6.16     .00   529.    980.10     715.69     1066.2 271.4 1568. 1915.9  1232.2 271.4  1261.8 .00021   .53892E-03  .52714E-03 1.67    88.
 19  6.19     .00   559.    980.10     700.45     1070.2 271.4 1576. 1924.0  1237.9 271.4  1267.3 .00021   .54100E-03  .52485E-03 1.67    87.
 20  6.21     .00   590.    980.10     685.21     1073.2 271.4 1581. 1930.2  1242.2 271.4  1271.5 .00021   .54333E-03  .52310E-03 1.67    86.
 21  6.23     .00   620.    980.10     669.97     1075.2 271.4 1585. 1934.2  1245.0 271.4  1274.3 .00021   .54600E-03  .52197E-03 1.67    86.
 22  6.27     .00   651.    980.10     654.73     1081.1 271.4 1596. 1946.3  1253.5 271.4  1282.5 .00020   .54688E-03  .51860E-03 1.67    85.
 23  6.29     .00   681.    980.10     639.49     1084.1 271.4 1601. 1952.6  1257.9 271.4  1286.8 .00020   .54886E-03  .51688E-03 1.67    84.
       WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366  4

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Figure 7-3 (Page 6 of 14)

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CASE-HOUR #    2           YEAR, DAY, HOUR: 76 366   4
                 WIND      MIXING                 AIR       TURB.      TURB.       VPTG,       VPTG,      DELTA       WSPD        WIND
     WIND      SPEED #1    HEIGHT    STABILITY    TEMP    INTENSITY  INTENSITY     PLUME       HCRIT      THETA      PROFILE    SPEED #2
  DIRECTION    (M/SEC)      (M)        CLASS       (K)       (Y)        (Z)      (DEG K/M)  (DEG K/M)   (DEG/M)    EXPONENT    (M/SEC)

    220.         3.00      1000.         1        293.15     .2200*     .2000*      .0000      .0000      .1000      -.0900      6.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =      .00 M
UTOP =  2.44 M/SEC,   FLUX =    254.59 M**4/S**3,  FINAL RISE =  440.76 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00

                                                                                                         CONVENTIONAL  REFLECTION
                         HT                                                                                VERTICAL     VERTICAL        CHI
                        ABOVE  PLUME HT   PLUME HT              SIGMA-Y                 SIGMA-Z       HORIZ.   DIST.       DIST.
                        STACK   BEFORE   CORRECTED                                                     DIST.   FACTOR      FACTOR        (UG/
 REC     X       Y      BASE   TERRAIN   BY TERRAIN  AMBIENT BUOY  SHEAR  TOTAL  AMBIENT BUOY   TOTAL  FACTOR  (1/M)       (1/M)     R  M**3)
  #    (KM)    (KM)     (M)      (M)        (M)        (M)    (M)    (M)    (M)     (M)    (M)    (M)   (1/M)

  1    3.26   -1.39    615.    562.68     281.34     623.6 139.4   427.   768.4  652.9 139.4   667.6 .00010 .14524E-02 .71018E-03 1.19   30.
  4     .82     .00    102.    487.19     436.14     174.1 115.5    89.   227.2  164.6 115.5   201.1 .00176 .37784E-03 .19836E-02 1.00  272.
  5     .99     .00    133.    535.98     469.66     208.5 130.9   122.   274.8  198.7 130.9   238.0 .00145 .47805E-03 .16782E-02 1.00  285.
  6    1.25     .00    163.    562.68     481.15     259.2 139.4   163.   336.6  249.9 139.4   286.2 .00119 .67834E-03 .14205E-02 1.02  330.
  7    1.32     .00    194.    562.68     465.91     273.0 139.4   173.   351.8  264.0 139.4   298.6 .00113 .79099E-03 .13812E-02 1.03  368.
  8    1.49     .00    224.    562.68     450.67     305.9 139.4   195.   388.5  298.0 139.4   329.0 .00103 .94985E-03 .12937E-02 1.07  400.
  9    1.70     .00    255.    562.68     435.43     345.1 139.4   222.   433.3  339.3 139.4   366.8 .00092 .10790E-02 .12613E-02 1.16  407.
 10    2.04     .00    285.    562.68     420.19     408.5 139.4   266.   507.2  407.4 139.4   430.6 .00079 .11712E-02 .12202E-02 1.32  378.
 11    2.22     .00    315.    562.68     404.95     442.1 139.4   290.   547.0  444.3 139.4   465.6 .00073 .12133E-02 .11285E-02 1.32  338.
 12    2.51     .00    346.    562.68     389.71     492.9 139.4   328.   608.1  501.1 139.4   520.2 .00066 .12392E-02 .10101E-02 1.32  272.
 13    2.86     .00    376.    562.68     374.47     554.9 139.4   374.   683.5  572.1 139.4   588.8 .00058 .12541E-02 .89238E-03 1.32  214.
 14    5.58    -.01    407.    562.68     359.23     983.3 139.4   729.  1232.2 1115.7 139.4 1124.4 .00032 .12554E-02 .46730E-03 1.32   62.
 15    5.75    -.01    437.    562.68     343.99    1007.8 139.4   752.  1264.9 1149.8 139.4 1158.2 .00032 .12799E-02 .45368E-03 1.32   59.
 16    6.05     .00    468.    562.68     328.75    1050.2 139.4   791.  1321.9 1209.4 139.4 1217.4 .00030 .13054E-02 .43160E-03 1.32   53.
 17    6.11     .00    498.    562.68     313.51    1059.2 139.4   799.  1334.1 1222.2 139.4 1230.2 .00030 .13319E-02 .42713E-03 1.32   52.
 18    6.16     .00    529.    562.68     298.27    1066.2 139.4   806.  1343.6 1232.2 139.4 1240.1 .00030 .13595E-02 .42371E-03 1.32   52.
 19    6.19     .00    559.    562.68     283.03    1070.2 139.4   809.  1348.9 1237.9 139.4 1245.7 .00030 .13882E-02 .36039E-03 1.13   44.
 20    6.21     .00    590.    562.68     281.34    1073.2 139.4   812.  1353.0 1242.2 139.4 1250.0 .00029 .14182E-02 .36904E-03 1.16   45.
 21    6.23     .00    620.    562.68     281.34    1075.2 139.4   814.  1355.7 1245.0 139.4 1252.8 .00029 .14496E-02 .38177E-03 1.20   46.
 22    6.27     .00    651.    562.68     281.34    1081.1 139.4   819.  1363.7 1253.5 139.4 1261.2 .00029 .14823E-02 .39905E-03 1.26   48.
 23    6.29     .00    681.    562.68     281.34    1084.1 139.4   822.  1367.8 1257.9 139.4 1265.6 .00029 .15166E-02 .41985E-03 1.33   50.
       WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366   9
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CASE-HOUR #    3           YEAR, DAY, HOUR: 76 366   9
                 WIND      MIXING                 AIR       TURB.      TURB.       VPTG,       VPTG,      DELTA       WSPD        WIND
     WIND      SPEED #1    HEIGHT    STABILITY    TEMP    INTENSITY  INTENSITY     PLUME       HCRIT      THETA      PROFILE    SPEED #2
  DIRECTION    (M/SEC)      (M)        CLASS       (K)       (Y)        (Z)      (DEG K/M)  (DEG K/M)   (DEG/M)    EXPONENT    (M/SEC)

    220.         2.00      3000.         2        293.15     .1600*     .1200*      .0000      .0000      .1200       .1100      4.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =      .00 M
UTOP =  2.63 M/SEC,   FLUX =    254.59 M**4/S**3,  FINAL RISE =  408.16 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00

                                                                                                         CONVENTIONAL  REFLECTION
                         HT                                                                                VERTICAL     VERTICAL        CHI
                        ABOVE  PLUME HT   PLUME HT              SIGMA-Y                 SIGMA-Z       HORIZ.   DIST.       DIST.
                        STACK   BEFORE   CORRECTED                                                     DIST.   FACTOR      FACTOR        (UG/
 REC     X       Y      BASE   TERRAIN   BY TERRAIN  AMBIENT BUOY  SHEAR  TOTAL  AMBIENT BUOY   TOTAL  FACTOR  (1/M)       (1/M)     R  M**3)
  #    (KM)    (KM)     (M)      (M)        (M)        (M)    (M)    (M)    (M)     (M)    (M)    (M)   (1/M)
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Figure 7-3 (Page 7 of 14)

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  1  3.26  -1.39  615.    530.08     265.04     453.5 129.1   474.   668.8   391.8 129.1   412.5 .00007   .15736E-02   .10818E-02 1.12    29.
  4   .82    .00  102.    460.17     409.12     126.6 107.0    99.   193.1    98.8 107.0   145.6 .00207   .10576E-03   .27400E-02 1.00    83.
  5   .99    .00  133.    505.35     439.05     151.6 121.3   136.   236.8   119.2 121.3   170.0 .00168   .16739E-03   .23461E-02 1.00   107.
  6  1.25    .00  163.    530.08     448.54     188.5 129.1   182.   291.8   150.0 129.1   197.9 .00137   .30872E-03   .20164E-02 1.00   160.
  7  1.32    .00  194.    530.08     433.30     198.5 129.1   192.   304.7   158.4 129.1   204.3 .00131   .41228E-03   .19526E-02 1.00   205.
  8  1.49    .00  224.    530.08     418.06     222.4 129.1   217.   336.2   178.8 129.1   220.5 .00119   .60001E-03   .18103E-02 1.00   270.
  9  1.70    .00  255.    530.08     402.82     251.0 129.1   247.   374.7   203.6 129.1   241.1 .00106   .81929E-03   .16612E-02 1.00   331.
 10  2.04    .00  285.    530.08     387.58     297.1 129.1   296.   438.8   244.5 129.1   276.4 .00091   .10802E-02   .14714E-02 1.02   373.
 11  2.22    .00  315.    530.08     372.34     321.5 129.1   323.   473.5   266.6 129.1   296.2 .00084   .12223E-02   .14092E-02 1.05   391.
 12  2.51    .00  346.    530.08     357.10     358.5 129.1   364.   527.0   300.7 129.1   327.2 .00076   .13442E-02   .13738E-02 1.13   386.
 13  2.86    .00  376.    530.08     341.86     403.6 129.1   416.   593.5   343.2 129.1   366.7 .00067   .14090E-02   .13072E-02 1.20   334.
 14  5.58   -.01  407.    530.08     326.62     715.1 129.1   811.  1088.6   669.4 129.1   681.8 .00037   .10434E-02   .10434E-02 1.78   145.
 15  5.75   -.01  437.    530.08     311.38     732.9 129.1   835.  1118.7   689.9 129.1   701.8 .00036   .10303E-02   .10303E-02 1.81   140.
 16  6.05    .00  468.    530.08     296.14     763.8 129.1   875.  1171.3   725.6 129.1   737.0 .00034   .99861E-03   .99861E-03 1.84   129.
 17  6.11    .00  498.    530.08     280.90     770.3 129.1   888.  1182.6   733.3 129.1   744.6 .00034   .99795E-03   .99795E-03 1.86   128.
 18  6.16    .00  529.    530.08     265.66     775.4 129.1   895.  1191.4   739.3 129.1   750.5 .00033   .99855E-03   .98444E-03 1.85   125.
 19  6.19    .00  559.    530.08     265.04     778.3 129.1   899.  1196.3   742.7 129.1   753.9 .00033   .99498E-03   .99498E-03 1.88   126.
 20  6.21    .00  590.    530.08     265.04     780.5 129.1   902.  1200.1   745.3 129.1   756.4 .00033   .99201E-03   .99201E-03 1.88   125.
 21  6.23    .00  620.    530.08     265.04     781.9 129.1   904.  1202.6   747.0 129.1   758.1 .00033   .99010E-03   .99010E-03 1.88   125.
 22  6.27    .00  651.    530.08     265.04     786.2 129.1   911.  1210.0   752.1 129.1   763.1 .00033   .98439E-03   .98439E-03 1.88   123.
 23  6.29    .00  681.    530.08     265.04     788.4 129.1   914.  1213.8   754.7 129.1   765.7 .00033   .98147E-03   .98147E-03 1.88   123.
        WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366 12

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CASE-HOUR #    4           YEAR, DAY, HOUR: 76 366 12
              WIND       MIXING                  AIR       TURB.      TURB.       VPTG,        VPTG,      DELTA       WSPD        WIND
   WIND     SPEED #1     HEIGHT   STABILITY     TEMP   INTENSITY  INTENSITY     PLUME        HCRIT      THETA      PROFILE    SPEED #2
DIRECTION   (M/SEC)       (M)       CLASS        (K)       (Y)        (Z)     (DEG K/M)   (DEG K/M)   (DEG/M)    EXPONENT    (M/SEC)

   220.      4.00        700.         2        293.15    .1600*     .1200*     .0000        .0000      .1200      -.1100      7.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =       .00 M
UTOP =  3.23 M/SEC,    FLUX =     254.59 M**4/S**3,  FINAL RISE =  332.83 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00

                     HT                                                                                     CONVENTIONAL  REFLECTION
                   ABOVE  PLUME HT   PLUME HT             SIGMA-Y                       SIGMA-Z           HORIZ.   VERTICAL     VERTICAL          CHI
                   STACK   BEFORE   CORRECTED                                                             DIST.      DIST.        DIST.
REC    X      Y    BASE   TERRAIN   BY TERRAIN    AMBIENT  BUOY  SHEAR   TOTAL  AMBIENT  BUOY    TOTAL  FACTOR     FACTOR       FACTOR             (UG/
 #   (KM)   (KM)    (M)     (M)        (M)          (M)    (M)    (M)     (M)     (M)    (M)      (M)   (1/M)      (1/M)        (1/M)       R   M**3)

  1  3.26  -1.39  615.    454.75     227.38     453.5 105.3   387.   605.3   391.8 105.3   405.6 .00005   .25406E-02   .13530E-02 1.38    20.
  4   .82    .00  102.    397.75     346.69     126.6  87.2    81.   173.7    98.8  87.2   131.8 .00230   .19017E-03   .30273E-02 1.00   135.
  5   .99    .00  133.    434.59     368.29     151.6  98.9   111.   212.1   119.2  98.9   154.9 .00188   .30489E-03   .25757E-02 1.00   178.
  6  1.25    .00  163.    454.75     373.22     188.5 105.3   148.   261.8   150.0 105.3   183.2 .00152   .54687E-03   .22545E-02 1.04   258.
  7  1.32    .00  194.    454.75     357.98     198.5 105.3   156.   273.8   158.4 105.3   190.2 .00146   .71385E-03   .21996E-02 1.05   322.
  8  1.49    .00  224.    454.75     342.74     222.4 105.3   177.   302.9   178.8 105.3   207.5 .00132   .98406E-03   .21004E-02 1.09   401.
  9  1.70    .00  255.    454.75     327.50     251.0 105.3   201.   338.4   203.6 105.3   229.2 .00118   .12601E-02   .20430E-02 1.17   460.
 10  2.04    .00  285.    454.75     312.26     297.1 105.3   241.   397.0   244.5 105.3   266.2 .00100   .15380E-02   .20543E-02 1.37   479.
 11  2.22    .00  315.    454.75     297.02     321.5 105.3   263.   428.6   266.6 105.3   286.6 .00093   .16910E-02   .21148E-02 1.52   487.
 12  2.51    .00  346.    454.75     281.78     358.5 105.3   297.   477.2   300.7 105.3   318.6 .00084   .18268E-02   .15673E-02 1.25   406.
 13  2.86    .00  376.    454.75     266.54     403.6 105.3   339.   537.4   343.2 105.3   359.0 .00074   .19312E-02   .13907E-02 1.25   320.
 14  5.58   -.01  407.    454.75     251.30     715.1 105.3   661.   979.5   669.4 105.3   677.7 .00041   .20139E-02   .73679E-03 1.25    93.
 15  5.75   -.01  437.    454.75     236.06     732.9 105.3   681.  1006.1   689.9 105.3   697.8 .00040   .20777E-02   .71549E-03 1.25    88.
 16  6.05    .00  468.    454.75     227.38     763.8 105.3   716.  1052.5   725.6 105.3   733.2 .00038   .21456E-02   .70761E-03 1.30    83.
 17  6.11    .00  498.    454.75     227.38     770.3 105.3   724.  1062.4   733.3 105.3   740.9 .00038   .22182E-02   .63564E-03 1.18    74.
 18  6.16    .00  529.    454.75     227.38     775.4 105.3   730.  1070.2   739.3 105.3   746.8 .00037   .22958E-02   .64713E-03 1.21    75.
 19  6.19    .00  559.    454.75     227.38     778.3 105.3   733.  1074.5   742.7 105.3   750.1 .00037   .23790E-02   .67006E-03 1.26    77.
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Figure 7-3 (Page 8 of 14)

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20  6.21     .00  590.   454.75      227.38      780.5 105.3  736. 1077.9  745.3 105.3  752.7 .00037  .24685E-02  .70009E-03 1.32    80.
21  6.23     .00  620.   454.75      227.38      781.9 105.3  738. 1080.1  747.0 105.3  754.4 .00037  .25650E-02  .73417E-03 1.39    84.
22  6.27     .00  651.   454.75      227.38      786.2 105.3  743. 1086.6  752.1 105.3  759.4 .00037  .26693E-02  .60997E-03 1.16    69.
23  6.29     .00  681.   454.75      227.38      788.4 105.3  745. 1090.0  754.7 105.3  762.0 .00037  .27825E-02  .61782E-03 1.18    70.
       WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366 14

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CASE-HOUR #     5          YEAR, DAY, HOUR: 76 366 14
            WIND       MIXING                  AIR       TURB.      TURB.       VPTG,      VPTG,     DELTA       WSPD       WIND
   WIND   SPEED #1     HEIGHT   STABILITY     TEMP    INTENSITY  INTENSITY     PLUME      HCRIT      THETA     PROFILE   SPEED #2
DIRECTION (M/SEC)       (M)       CLASS        (K)       (Y)        (Z)      (DEG K/M)  (DEG K/M)  (DEG/M)    EXPONENT   (M/SEC)

   220.     2.00       3000.        3        293.15     .1100*     .0800*      .0000      .0000      .1500      .1200      4.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =      .00 M
UTOP =  2.70 M/SEC,   FLUX =    254.59 M**4/S**3,  FINAL RISE =  398.08 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00

                                                                                              CONVENTIONAL REFLECTION
                    HT                                                                                                      
                  ABOVE PLUME HT  PLUME HT            SIGMA-Y                  SIGMA-Z          HORIZ.   VERTICAL    VERTICAL        CHI
                  STACK  BEFORE  CORRECTED                                                       DIST.     DIST.       DIST.
REC   X      Y    BASE  TERRAIN  BY TERRAIN   AMBIENT BUOY SHEAR   TOTAL AMBIENT BUOY   TOTAL  FACTOR    FACTOR      FACTOR          (UG/
 #   (KM)   (KM)   (M)    (M)       (M)         (M)   (M)   (M)     (M)    (M)   (M)     (M)   (1/M)     (1/M)       (1/M)     R   M**3)

 1  3.26  -1.39  615.   520.00     260.00      311.8 125.9  578.   668.9  203.1 125.9  239.0 .00007  .18474E-02  .16810E-02 1.01    43.
 4   .82    .00  102.   451.82     400.76       87.0 104.3  121.   181.8   61.0 104.3  120.9 .00219  .27041E-04  .33009E-02 1.00    22.
 5   .99    .00  133.   495.88     429.58      104.2 118.3  165.   228.4   72.6 118.3  138.8 .00175  .47691E-04  .28751E-02 1.00    31.
 6  1.25    .00  163.   520.00     438.46      129.6 125.9  221.   285.7   89.4 125.9  154.4 .00140  .91689E-04  .25837E-02 1.00    47.
 7  1.32    .00  194.   520.00     423.22      136.5 125.9  234.   298.6   93.9 125.9  157.1 .00134  .13467E-03  .25399E-02 1.00    67.
 8  1.49    .00  224.   520.00     407.98      152.9 125.9  264.   330.0  104.6 125.9  163.7 .00121  .21829E-03  .24371E-02 1.00    98.
 9  1.70    .00  255.   520.00     392.74      172.6 125.9  301.   368.7  117.3 125.9  172.0 .00108  .34258E-03  .23188E-02 1.00   137.
10  2.04    .00  285.   520.00     377.50      204.2 125.9  361.   433.3  137.4 125.9  186.3 .00092  .54996E-03  .21417E-02 1.00   188.
11  2.22    .00  315.   520.00     362.26      221.0 125.9  393.   468.5  147.9 125.9  194.2 .00085  .72120E-03  .20563E-02 1.00   227.
12  2.51    .00  346.   520.00     347.02      246.5 125.9  444.   523.1  163.6 125.9  206.4 .00076  .94086E-03  .19393E-02 1.00   266.
13  2.86    .00  376.   520.00     331.78      277.5 125.9  507.   591.2  182.5 125.9  221.7 .00067  .11745E-02  .18198E-02 1.01   294.
14  5.58   -.01  407.   520.00     316.54      491.7 125.9  988. 1110.9  306.8 125.9  331.6 .00036  .15256E-02  .15256E-02 1.27   203.
15  5.75   -.01  437.   520.00     301.30      503.9 125.9 1018. 1143.1  313.7 125.9  338.0 .00035  .15866E-02  .12862E-02 1.09   166.
16  6.05    .00  468.   520.00     286.06      525.1 125.9 1071. 1199.5  325.5 125.9  349.0 .00033  .16340E-02  .12457E-02 1.09   153.
17  6.11    .00  498.   520.00     270.82      529.6 125.9 1082. 1211.7  328.0 125.9  351.3 .00033  .16874E-02  .12375E-02 1.09   151.
18  6.16    .00  529.   520.00     260.00      533.1 125.9 1091. 1221.1  329.9 125.9  353.1 .00033  .17231E-02  .12311E-02 1.09   149.
19  6.19    .00  559.   520.00     260.00      535.1 125.9 1096. 1226.4  331.0 125.9  354.1 .00033  .17208E-02  .12276E-02 1.09   148.
20  6.21    .00  590.   520.00     260.00      536.6 125.9 1100. 1230.5  331.8 125.9  354.9 .00032  .17190E-02  .12249E-02 1.09   147.
21  6.23    .00  620.   520.00     260.00      537.6 125.9 1103. 1233.2  332.4 125.9  355.4 .00032  .17179E-02  .13328E-02 1.19   160.
22  6.27    .00  651.   520.00     260.00      540.5 125.9 1110. 1241.2  334.0 125.9  356.9 .00032  .17145E-02  .14361E-02 1.28   171.
23  6.29    .00  681.   520.00     260.00      542.1 125.9 1114. 1245.3  334.8 125.9  357.7 .00032  .17127E-02  .14670E-02 1.32   174.
       WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366 19

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CASE-HOUR #     6          YEAR, DAY, HOUR: 76 366 19
            WIND       MIXING                  AIR       TURB.      TURB.       VPTG,      VPTG,     DELTA       WSPD       WIND
   WIND   SPEED #1     HEIGHT   STABILITY     TEMP    INTENSITY  INTENSITY     PLUME      HCRIT      THETA     PROFILE   SPEED #2
DIRECTION (M/SEC)       (M)       CLASS        (K)       (Y)        (Z)      (DEG K/M)  (DEG K/M)  (DEG/M)    EXPONENT   (M/SEC)

   220.     7.00        550.        3        293.15     .1100*     .0800*      .0000      .0000      .1500     -.1200     14.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN
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Figure 7-3 (Page 9 of 14)

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STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =      .00 M
UTOP =  5.70 M/SEC,   FLUX =    254.59 M**4/S**3,  FINAL RISE =  188.40 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00


                   HT                                                                                CONVENTIONAL REFLECTION
                 ABOVE PLUME HT   PLUME HT            SIGMA-Y                   SIGMA-Z         HORIZ.    VERTICAL    VERTICAL       CHI
                 STACK  BEFORE  CORRECTED                                                        DIST.       DIST.       DIST.
REC     X      Y  BASE   TERRAIN  BY TERRAIN    AMBIENT  BUOY SHEAR  TOTAL AMBIENT  BUOY  TOTAL FACTOR      FACTOR      FACTOR          (UG/
 #   (KM)   (KM)   (M)       (M)         (M)        (M)   (M)   (M)    (M)    (M)   (M)    (M)  (1/M)       (1/M)       (1/M)    R  M**3)

  1  3.26  -1.39  615.    310.32      155.16      311.8  59.6  274.  419.1  203.1  59.6  211.7 .00000  .35579E-02  .20353E-02 1.08     1.
  4   .82    .00  102.    278.05      226.99       87.0  49.4   57.  115.3   61.0  49.4   78.5 .00346  .15529E-03  .50824E-02 1.00    94.
  5   .99    .00  133.    298.90      232.61      104.2  56.0   78.  141.8   72.6  56.0   91.7 .00281  .34787E-03  .43523E-02 1.00   171.
  6  1.25    .00  163.    310.32      228.78      129.6  59.6  105.  177.0   89.4  59.6  107.4 .00225  .76961E-03  .37133E-02 1.00   304.
  7  1.32    .00  194.    310.32      213.54      136.5  59.6  111.  185.5   93.9  59.6  111.2 .00215  .11362E-02  .35887E-02 1.00   420.
  8  1.49    .00  224.    310.32      198.30      152.9  59.6  125.  206.3  104.6  59.6  120.4 .00193  .17074E-02  .33291E-02 1.00   579.
  9  1.70    .00  255.    310.32      183.06      172.6  59.6  142.  231.4  117.3  59.6  131.5 .00172  .23032E-02  .31019E-02 1.02   696.
 10  2.04    .00  285.    310.32      167.82      204.2  59.6  171.  272.8  137.4  59.6  149.7 .00146  .28439E-02  .29549E-02 1.11   729.
 11  2.22    .00  315.    310.32      155.16      221.0  59.6  186.  295.1  147.9  59.6  159.4 .00135  .31188E-02  .27522E-02 1.10   652.
 12  2.51    .00  346.    310.32      155.16      246.5  59.6  210.  329.3  163.6  59.6  174.1 .00121  .30932E-02  .25207E-02 1.10   535.
 13  2.86    .00  376.    310.32      155.16      277.5  59.6  240.  371.5  182.5  59.6  192.0 .00107  .30500E-02  .22600E-02 1.09   425.
 14  5.58   -.01  407.    310.32      155.16      491.7  59.6  468.  681.2  306.8  59.6  312.6 .00059  .29027E-02  .28213E-02 2.21   290.
 15  5.75   -.01  437.    310.32      155.16      503.9  59.6  482.  699.8  313.7  59.6  319.3 .00057  .30245E-02  .28633E-02 2.29   286.
 16  6.05    .00  468.    310.32      155.16      525.1  59.6  507.  732.3  325.5  59.6  330.9 .00054  .31647E-02  .25785E-02 2.14   246.
 17  6.11    .00  498.    310.32      155.16      529.6  59.6  512.  739.3  328.0  59.6  333.3 .00054  .33234E-02  .21572E-02 1.80   204.
 18  6.16    .00  529.    310.32      155.16      533.1  59.6  516.  744.7  329.9  59.6  335.2 .00054  .35005E-02  .27429E-02 2.30   258.
 19  6.19    .00  559.    310.32      155.16      535.1  59.6  519.  747.7  331.0  59.6  336.3 .00053  .36355E-02  .21349E-02 1.80   200.
 20  6.21    .00  590.    310.32      155.16      536.6  59.6  521.  750.1  331.8  59.6  337.1 .00053  .36355E-02  .27100E-02 2.29   253.
 21  6.23    .00  620.    310.32      155.16      537.6  59.6  522.  751.6  332.4  59.6  337.7 .00053  .36355E-02  .12835E-02 1.09   119.
 22  6.27    .00  651.    310.32      155.16      540.5  59.6  525.  756.2  334.0  59.6  339.3 .00053  .36356E-02  .22090E-02 1.88   204.
 23  6.29    .00  681.    310.32      155.16      542.1  59.6  527.  758.5  334.8  59.6  340.1 .00053  .36356E-02  .26858E-02 2.29   248.
          WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77   1  5


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 CASE-HOUR #    7            YEAR, DAY, HOUR: 77   1  5
              WIND       MIXING                   AIR       TURB.       TURB.       VPTG,       VPTG,      DELTA       WSPD       WIND
   WIND     SPEED #1     HEIGHT     STABILITY     TEMP    INTENSITY   INTENSITY     PLUME       HCRIT      THETA     PROFILE    SPEED #2
 DIRECTION  (M/SEC)       (M)         CLASS       (K)        (Y)         (Z)      (DEG K/M)   (DEG K/M)   (DEG/M)    EXPONENT    (M/SEC)

    220.      3.00       1000.          4        293.15     .0800*      .0600*      .0000       .0000      .2000       .1400      6.00*

 * FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =      .00 M
UTOP =  4.26 M/SEC,   FLUX =    254.59 M**4/S**3,  FINAL RISE =  252.44 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00


                   HT                                                                                CONVENTIONAL REFLECTION
                 ABOVE PLUME HT   PLUME HT            SIGMA-Y                   SIGMA-Z         HORIZ.    VERTICAL    VERTICAL       CHI
                 STACK  BEFORE  CORRECTED                                                        DIST.       DIST.       DIST.
REC     X      Y  BASE   TERRAIN  BY TERRAIN    AMBIENT  BUOY SHEAR  TOTAL AMBIENT  BUOY  TOTAL FACTOR      FACTOR      FACTOR          (UG/
 #   (KM)   (KM)   (M)       (M)         (M)        (M)   (M)   (M)    (M)    (M)   (M)    (M)  (1/M)       (1/M)       (1/M)    R  M**3)

  1  3.26  -1.39  615.    374.36      187.18      226.8  79.8  489.  544.8   80.7  79.8  113.5 .00003  .18041E-02  .35306E-02 1.00    12.
  4   .82    .00  102.    331.12      280.07       63.3  66.2  102.  137.2   33.0  66.2   73.9 .00291  .82821E-05  .53950E-02 1.00     6.
  5   .99    .00  133.    359.06      292.77       75.8  75.0  140.  175.8   37.8  75.0   84.0 .00227  .21776E-04  .47511E-02 1.00    12.
  6  1.25    .00  163.    374.36      292.82       94.3  79.8  187.  224.2   44.2  79.8   91.3 .00178  .50810E-04  .43715E-02 1.00    21.
  7  1.32    .00  194.    374.36      277.58       99.3  79.8  198.  235.2   45.9  79.8   92.1 .00170  .92083E-04  .43328E-02 1.00    37.
  8  1.49    .00  224.    374.36      262.34      111.2  79.8  223.  261.8   49.7  79.8   94.0 .00152  .17326E-03  .42422E-02 1.00    62.
  9  1.70    .00  255.    374.36      247.10      125.5  79.8  254.  294.4   54.1  79.8   96.4 .00135  .31004E-03  .41378E-02 1.00    99.
 10  2.04    .00  285.    374.36      231.86      148.5  79.8  305.  348.6   60.7  79.8  100.3 .00114  .54934E-03  .39783E-02 1.00   148.
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Figure 7-3 (Page 10 of 14)

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 11  2.22    .00  315.   374.36     216.62     160.8  79.8  333.  378.0   64.0  79.8  102.3 .00106  .82976E-03  .38988E-02 1.00  206.
 12  2.51    .00  346.   374.36     201.38     179.3  79.8  375.  423.5   68.9  79.8  105.5 .00094  .12220E-02  .37853E-02 1.00  270.
 13  2.86    .00  376.   374.36     187.18     201.8  79.8  428.  480.2   74.6  79.8  109.3 .00083  .16836E-02  .36613E-02 1.00  329.
 14  5.58   -.01  407.   374.36     187.18     357.6  79.8  836.  912.3  109.4  79.8  135.4 .00044  .22663E-02  .30109E-02 1.02  233.
 15  5.75   -.01  437.   374.36     187.18     366.5  79.8  861.  939.1  111.2  79.8  136.9 .00042  .22884E-02  .29838E-02 1.02  228.
 16  6.05    .00  468.   374.36     187.18     381.9  79.8  906.  986.1  114.3  79.8  139.4 .00040  .23242E-02  .29389E-02 1.03  221.
 17  6.11    .00  498.   374.36     187.18     385.2  79.8  915.  996.2  115.0  79.8  140.0 .00040  .23314E-02  .29296E-02 1.03  219.
 18  6.16    .00  529.   374.36     187.18     387.7  79.8  923. 1004.1  115.5  79.8  140.4 .00040  .23369E-02  .29225E-02 1.03  218.
 19  6.19    .00  559.   374.36     187.18     389.2  79.8  927. 1008.5  115.8  79.8  140.7 .00040  .23400E-02  .29185E-02 1.03  217.
 20  6.21    .00  590.   374.36     187.18     390.3  79.8  930. 1011.9  116.0  79.8  140.8 .00039  .23424E-02  .29155E-02 1.03  217.
 21  6.23    .00  620.   374.36     187.18     391.0  79.8  932. 1014.2  116.2  79.8  141.0 .00039  .23439E-02  .29135E-02 1.03  217.
 22  6.27    .00  651.   374.36     187.18     393.1  79.8  939. 1020.0  116.6  79.8  141.3 .00039  .23484E-02  .29077E-02 1.03  216.
 23  6.29    .00  681.   374.36     187.18     394.2  79.8  942. 1024.2  116.8  79.8  141.5 .00039  .23507E-02  .29047E-02 1.03  215.
          WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77   1 11

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CASE-HOUR #    8             YEAR, DAY, HOUR: 77   1 11
            WIND      MIXING                   AIR     TURB.     TURB.       VPTG,      VPTG,     DELTA      WSPD       WIND
   WIND    SPEED #1   HEIGHT    STABILITY     TEMP   INTENSITY INTENSITY    PLUME      HCRIT      THETA     PROFILE   SPEED #2
DIRECTION  (M/SEC)      (M)       CLASS        (K)      (Y)       (Z)     (DEG K/M)  (DEG K/M)  (DEG/M)   EXPONENT   (M/SEC)

   220.     15.00      450.         4        293.15    .0800*    .0600*     .0000      .0000      .2000     -.1400     30.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =       .00 M
UTOP = 10.57 M/SEC,    FLUX =    254.59 M**4/S**3,  FINAL RISE =  101.69 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00

                      HT
                     ABOVE PLUME HT  PLUME HT             SIGMA-Y                     SIGMA-Z                   CONVENTIONAL REFLECTION
                     STACK  BEFORE  CORRECTED                                                       HORIZ.   VERTICAL    VERTICAL          CHI
REC    X      Y      BASE  TERRAIN  BY TERRAIN  AMBIENT BUOY SHEAR  TOTAL AMBIENT BUOY   TOTAL  DIST.     DIST.       DIST.
 #    (KM)   (KM)     (M)     (M)       (M)        (M)    (M)   (M)    (M)     (M)    (M)     (M)   FACTOR    FACTOR      FACTOR            (UG/
                                                                                                    (1/M)     (1/M)       (1/M)        R   M**3)

  4    .82    .00  102.   206.19     155.14      63.3  26.6   41.   80.1   33.0  26.6   42.4 .00498  .23630E-04  .93984E-02 1.00   11.
  5    .99    .00  133.   217.45     151.16      75.8  30.2   56.   99.1   37.8  30.2   48.4 .00402  .12493E-03  .82480E-02 1.00   48.
  6   1.25    .00  163.   223.61     142.08      94.3  32.2   75.  124.9   44.2  32.2   54.7 .00319  .49893E-03  .72960E-02 1.00  151.
  7   1.32    .00  194.   223.61     126.84      99.3  32.2   80.  131.3   45.9  32.2   56.0 .00304  .10983E-02  .71202E-02 1.00  316.
  8   1.49    .00  224.   223.61     111.81     111.2  32.2   90.  146.6   49.7  32.2   59.2 .00272  .22656E-02  .67437E-02 1.00  583.
  9   1.70    .00  255.   223.61     111.81     125.5  32.2  102.  165.1   54.1  32.2   62.9 .00242  .26140E-02  .63532E-02 1.00  598.
 10   2.04    .00  285.   223.61     111.81     148.5  32.2  123.  195.5   60.7  32.2   68.7 .00204  .30882E-02  .58372E-02 1.00  596.
 11   2.22    .00  315.   223.61     111.81     160.8  32.2  134.  211.7   64.0  32.2   71.7 .00188  .32964E-02  .56101E-02 1.01  588.
 12   2.51    .00  346.   223.61     111.81     179.3  32.2  151.  236.7   68.9  32.2   76.1 .00169  .35606E-02  .53152E-02 1.01  568.
 13   2.86    .00  376.   223.61     111.81     201.8  32.2  173.  267.5   74.6  32.2   81.2 .00149  .38100E-02  .50262E-02 1.02  538.
 14   5.58   -.01  407.   223.61     111.81     357.6  32.2  337.  492.1  109.4  32.2  114.0 .00081  .43528E-02  .42866E-02 1.22  329.
 15   5.75   -.01  437.   223.61     111.81     366.5  32.2  347.  505.6  111.2  32.2  115.7 .00079  .43931E-02  .44536E-02 1.29  328.
 16   6.05    .00  468.   223.61     111.81     381.9  32.2  365.  529.1  114.3  32.2  118.8 .00075  .44298E-02  .43391E-02 1.29  310.
 17   6.11    .00  498.   223.61     111.81     385.2  32.2  369.  534.2  115.0  32.2  119.4 .00075  .44316E-02  .42458E-02 1.27  300.
 18   6.16    .00  529.   223.61     111.81     387.7  32.2  372.  538.1  115.5  32.2  119.9 .00074  .44329E-02  .37954E-02 1.14  266.
 19   6.19    .00  559.   223.61     111.81     389.2  32.2  373.  540.3  115.8  32.2  120.2 .00074  .44336E-02  .42857E-02 1.29  299.
 20   6.21    .00  590.   223.61     111.81     390.3  32.2  375.  542.0  116.0  32.2  120.4 .00074  .44341E-02  .36930E-02 1.11  257.
 21   6.23    .00  620.   223.61     111.81     391.0  32.2  376.  543.1  116.2  32.2  120.5 .00073  .44344E-02  .42039E-02 1.27  292.
 22   6.27    .00  651.   223.61     111.81     393.1  32.2  378.  546.4  116.6  32.2  121.0 .00073  .44354E-02  .43721E-02 1.33  302.
 23   6.29    .00  681.   223.61     111.81     394.2  32.2  379.  548.1  116.8  32.2  121.2 .00073  .44359E-02  .35927E-02 1.09  247.
          WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77   1 13

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CASE-HOUR #    9             YEAR, DAY, HOUR: 77   1 13
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Figure 7-3 (Page 11 of 14)

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              WIND     MIXING                  AIR      TURB.      TURB.      VPTG,      VPTG,     DELTA       WSPD       WIND
   WIND     SPEED #1   HEIGHT    STABILITY    TEMP   INTENSITY  INTENSITY    PLUME      HCRIT      THETA     PROFILE   SPEED #2
 DIRECTION  (M/SEC)     (M)        CLASS       (K)       (Y)        (Z)    (DEG K/M)  (DEG K/M)  (DEG/M)    EXPONENT   (M/SEC)

    220.      2.00     9999.         5       293.15    .0600*     .0300*     .0200      .0200      .3000      .2000      5.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =   553.72 M
UTOP =  3.30 M/SEC,    FLUX =    254.59 M**4/S**3,  FINAL RISE =  126.55 M,  DISTANCE TO FINAL RISE =   263.94 M,  PEN. FRAC. =  .00

                      HT                                                                                     CONVENTIONAL REFLECTION
                    ABOVE PLUME HT  PLUME HT             SIGMA-Y                      SIGMA-Z           HORIZ.   VERTICAL     VERTICAL          CHI
                    STACK  BEFORE  CORRECTED                                                            DIST.     DIST.        DIST.
REC    X      Y     BASE  TERRAIN  BY TERRAIN  AMBIENT BUOY SHEAR   TOTAL AMBIENT BUOY    TOTAL FACTOR     FACTOR       FACTOR            (UG/
 #   (KM)   (KM)    (M)     (M)        (M)       (M)    (M)   (M)     (M)     (M)   (M)      (M)  (1/M)      (1/M)        (1/M)        R   M**3)

  1  3.26  -1.39  615.    248.47    -366.31     170.1  40.0  368.   407.1    49.5  40.0     63.6 .00000   .80026E-09   .64045E-02 1.02     0.
  4   .82    .00  102.    248.47     146.36      47.5  40.0   93.   111.6    19.8  40.0     44.7 .00358   .82971E-04   .89346E-02 1.00    90.
  5   .99    .00  133.    248.47     115.88      56.9  40.0  112.   131.7    23.0  40.0     46.1 .00303   .73796E-03   .86467E-02 1.00   678.
  6  1.25    .00  163.    248.47      85.40      70.7  40.0  141.   162.5    27.3  40.0     48.4 .00245   .34791E-02   .82547E-02 1.00  2589.
  7  1.32    .00  194.    248.47      54.92      74.4  40.0  149.   171.0    28.4  40.0     49.1 .00233   .86906E-02   .81736E-02 1.01  5781.
  8  1.49    .00  224.    248.47      24.44      83.4  40.0  168.   191.6    30.9  40.0     50.6 .00208   .14041E-01   .79311E-02 1.01  5006.
  9  1.70    .00  255.    248.47      -6.04      94.1  40.0  191.   216.7    33.7  40.0     52.3 .00184   .15144E-01   .76608E-02 1.01  4276.
 10  2.04    .00  285.    248.47     -36.52     111.4  40.0  229.   258.2    37.9  40.0     55.1 .00155   .11621E-01   .72500E-02 1.00  3397.
 11  2.22    .00  315.    248.47     -67.00     120.6  40.0  250.   280.6    40.0  40.0     56.6 .00142   .69952E-02   .70864E-02 1.00  3016.
 12  2.51    .00  346.    248.47     -97.48     134.4  40.0  282.   315.1    42.9  40.0     58.7 .00127   .34215E-02   .68745E-02 1.01  1313.
 13  2.86    .00  376.    248.47    -127.96     151.3  40.0  322.   358.2    46.2  40.0     61.1 .00111   .14580E-02   .65330E-02 1.00   492.
 14  5.58   -.01  407.    248.47    -158.44     268.2  40.0  628.   684.3    62.6  40.0     74.3 .00058   .11053E-02   .53761E-02 1.00   195.
 15  5.75   -.01  437.    248.47    -188.92     274.9  40.0  647.   704.5    63.3  40.0     74.9 .00057   .44221E-03   .53380E-02 1.00    76.
 16  6.05    .00  468.    248.47    -219.40     286.4  40.0  681.   739.9    64.5  40.0     75.9 .00054   .16081E-03   .52745E-02 1.00    26.
 17  6.11    .00  498.    248.47    -249.88     288.9  40.0  688.   747.5    64.7  40.0     76.1 .00053   .47679E-04   .52692E-02 1.00     8.
 18  6.16    .00  529.    248.47    -280.36     290.8  40.0  694.   753.4    64.9  40.0     76.2 .00053   .12116E-04   .52714E-02 1.01     2.
 19  6.19    .00  559.    248.47    -310.84     291.9  40.0  697.   756.8    65.0  40.0     76.3 .00053   .26183E-05   .52841E-02 1.01     0.
 20  6.21    .00  590.    248.47    -341.32     292.7  40.0  700.   759.3    65.1  40.0     76.4 .00053   .48359E-06   .53058E-02 1.02     0.
 21  6.23    .00  620.    248.47    -371.80     293.2  40.0  701.   761.0    65.1  40.0     76.4 .00052   .76107E-07   .53392E-02 1.02     0.
 22  6.27    .00  651.    248.47    -402.28     294.8  40.0  706.   766.0    65.3  40.0     76.6 .00052   .10578E-07   .53794E-02 1.03     0.
 23  6.29    .00  681.    248.47    -432.76     295.7  40.0  708.   768.6    65.4  40.0     76.6 .00052   .12403E-08   .54692E-02 1.05     0.
        WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77   1 16

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 CASE-HOUR #    10           YEAR, DAY, HOUR: 77   1 16
              WIND     MIXING                  AIR      TURB.      TURB.      VPTG,      VPTG,     DELTA       WSPD       WIND
   WIND     SPEED #1   HEIGHT    STABILITY    TEMP   INTENSITY  INTENSITY    PLUME      HCRIT      THETA     PROFILE   SPEED #2
 DIRECTION  (M/SEC)     (M)        CLASS       (K)       (Y)        (Z)    (DEG K/M)  (DEG K/M)  (DEG/M)    EXPONENT   (M/SEC)

    220.      4.00     9999.         5       293.15    .0600*     .0300*     .0030      .0050      .3000     -.2000     10.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =   493.66 M
UTOP =  2.43 M/SEC,    FLUX =    254.59 M**4/S**3,  FINAL RISE =  263.84 M,  DISTANCE TO FINAL RISE =   501.25 M,  PEN. FRAC. =  .00

                      HT                                                                                     CONVENTIONAL REFLECTION
                    ABOVE PLUME HT  PLUME HT             SIGMA-Y                      SIGMA-Z           HORIZ.   VERTICAL     VERTICAL          CHI
                    STACK  BEFORE  CORRECTED                                                            DIST.     DIST.        DIST.
REC    X      Y     BASE  TERRAIN  BY TERRAIN  AMBIENT BUOY SHEAR   TOTAL AMBIENT BUOY    TOTAL FACTOR     FACTOR       FACTOR            (UG/
 #   (KM)   (KM)    (M)     (M)        (M)       (M)    (M)   (M)     (M)     (M)   (M)      (M)  (1/M)      (1/M)        (1/M)        R   M**3)
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Figure 7-3 (Page 12 of 14)

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  1  3.26  -1.39  615.    385.76    -229.02     170.1  83.4  767.   789.6    49.5  83.4    97.0 .00011  .50660E-03  .41275E-02 1.00    23.
  4   .82    .00  102.    385.76     283.65      47.5  83.4  193.   215.8    19.8  83.4    85.8 .00185  .39151E-04  .46523E-02 1.00    30.
  5   .99    .00  133.    385.76     253.17      56.9  83.4  233.   254.2    23.0  83.4    86.5 .00157  .12767E-03  .46102E-02 1.00    83.
  6  1.25    .00  163.    385.76     222.69      70.7  83.4  293.   313.1    27.3  83.4    87.8 .00127  .36382E-03  .45450E-02 1.00   191.
  7  1.32    .00  194.    385.76     192.21      74.4  83.4  310.   329.5    28.4  83.4    88.1 .00121  .83909E-03  .45271E-02 1.00   419.
  8  1.49    .00  224.    385.76     161.73      83.4  83.4  350.   369.3    30.9  83.4    89.0 .00108  .17185E-02  .44901E-02 1.00   765.
  9  1.70    .00  255.    385.76     131.25      94.1  83.4  398.   417.7    33.7  83.4    90.0 .00095  .30609E-02  .44687E-02 1.01  1205.
 10  2.04    .00  285.    385.76     100.77     111.4  83.4  478.   498.2    37.9  83.4    91.7 .00080  .47566E-02  .43879E-02 1.01  1449.
 11  2.22    .00  315.    385.76      70.29     120.6  83.4  522.   541.8    40.0  83.4    92.5 .00074  .64620E-02  .43466E-02 1.01  1319.
 12  2.51    .00  346.    385.76      39.81     134.4  83.4  588.   609.3    42.9  83.4    93.8 .00065  .77721E-02  .42863E-02 1.01  1157.
 13  2.86    .00  376.    385.76       9.33     151.3  83.4  672.   693.5    46.2  83.4    95.4 .00058  .83270E-02  .41931E-02 1.00   994.
 14  5.58   -.01  407.    385.76     -21.15     268.2  83.4 1310.  1339.7    62.6  83.4   104.3 .00030  .74939E-02  .38392E-02 1.00   471.
 15  5.75   -.01  437.    385.76     -51.63     274.9  83.4 1350.  1380.0    63.3  83.4   104.7 .00029  .67469E-02  .38323E-02 1.01   457.
 16  6.05    .00  468.    385.76     -82.11     286.4  83.4 1420.  1450.9    64.5  83.4   105.4 .00027  .55880E-02  .38194E-02 1.01   433.
 17  6.11    .00  498.    385.76    -112.59     288.9  83.4 1435.  1466.1    64.7  83.4   105.6 .00027  .42797E-02  .37836E-02 1.00   424.
 18  6.16    .00  529.    385.76    -143.07     290.8  83.4 1447.  1477.9    64.9  83.4   105.7 .00027  .30201E-02  .37810E-02 1.00   336.
 19  6.19    .00  559.    385.76    -173.55     291.9  83.4 1453.  1484.6    65.0  83.4   105.8 .00027  .19629E-02  .37807E-02 1.00   217.
 20  6.21    .00  590.    385.76    -204.03     292.7  83.4 1458.  1489.8    65.1  83.4   105.8 .00027  .11749E-02  .37814E-02 1.00   130.
 21  6.23    .00  620.    385.76    -234.51     293.2  83.4 1462.  1493.1    65.1  83.4   105.8 .00027  .64755E-03  .37833E-02 1.00    71.
 22  6.27    .00  651.    385.76    -264.99     294.8  83.4 1472.  1503.2    65.3  83.4   105.9 .00027  .32976E-03  .37837E-02 1.00    36.
 23  6.29    .00  681.    385.76    -295.47     295.7  83.4 1477.  1508.4    65.4  83.4   106.0 .00026  .15453E-03  .37867E-02 1.01    17.
        WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77   1 19

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CASE-HOUR #   11           YEAR, DAY, HOUR: 77   1 19
               WIND      MIXING               AIR      TURB.      TURB.       VPTG,       VPTG,      DELTA      WSPD        WIND
    WIND     SPEED #1    HEIGHT   STABILITY   TEMP   INTENSITY  INTENSITY     PLUME       HCRIT      THETA     PROFILE    SPEED #2
 DIRECTION   (M/SEC)      (M)       CLASS      (K)       (Y)        (Z)      (DEG K/M)  (DEG K/M)   (DEG/M)   EXPONENT    (M/SEC)

   220.        2.50      9999.        6      293.15    .0400*     .0160*      .0060       .0200      .4000      .3000       7.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =   476.56 M
UTOP =  5.29 M/SEC,    FLUX =    254.59 M**4/S**3,  FINAL RISE =  161.45 M,  DISTANCE TO FINAL RISE =   773.49 M,  PEN. FRAC. =  .00

                                                                                                    CONVENTIONAL REFLECTION
                      HT                                                                                                         
                    ABOVE PLUME HT  PLUME HT           SIGMA-Y                    SIGMA-Z         HORIZ.   VERTICAL   VERTICAL        CHI
                    STACK  BEFORE   CORRECTED                                                      DIST.      DIST.      DIST.
REC    X       Y     BASE  TERRAIN  BY TERRAIN  AMBIENT BUOY SHEAR  TOTAL AMBIENT BUOY    TOTAL FACTOR     FACTOR     FACTOR           (UG/
 #   (KM)   (KM)     (M)     (M)        (M)       (M)    (M)   (M)    (M)    (M)    (M)     (M)  (1/M)      (1/M)      (1/M)      R  M**3)

  1  3.26  -1.39  615.    283.37    -331.41     113.4  51.1  625.   637.7    26.4  51.1    57.5 .00006  .83536E-09  .69418E-02 1.00     0.
  4   .82    .00  102.    283.37     181.26      31.7  51.1  158.   168.8    10.6  51.1    52.1 .00236  .36311E-04  .76519E-02 1.00    16.
  5   .99    .00  133.    283.37     150.78      37.9  51.1  190.   200.7    12.2  51.1    52.5 .00199  .24592E-03  .75984E-02 1.00    92.
  6  1.25    .00  163.    283.37     120.30      47.1  51.1  239.   249.3    14.5  51.1    53.1 .00160  .11528E-02  .75150E-02 1.00   348.
  7  1.32    .00  194.    283.37      89.82      49.6  51.1  253.   262.7    15.1  51.1    53.3 .00152  .36121E-02  .74991E-02 1.00  1036.
  8  1.49    .00  224.    283.37      59.34      55.6  51.1  285.   295.3    16.5  51.1    53.6 .00135  .80665E-02  .74435E-02 1.00  1899.
  9  1.70    .00  255.    283.37      28.86      62.7  51.1  325.   334.9    18.0  51.1    54.1 .00119  .12786E-01  .73770E-02 1.00  1660.
 10  2.04    .00  285.    283.37      -1.62      74.3  51.1  390.   400.5    20.2  51.1    54.9 .00100  .14522E-01  .72663E-02 1.00  1367.
 11  2.22    .00  315.    283.37     -32.10      80.4  51.1  426.   436.1    21.3  51.1    55.3 .00091  .12187E-01  .72130E-02 1.00  1246.
 12  2.51    .00  346.    283.37     -62.58      89.6  51.1  480.   491.0    22.9  51.1    56.0 .00081  .76298E-02  .71349E-02 1.00  1095.
 13  2.86    .00  376.    283.37     -93.06     100.9  51.1  548.   559.5    24.6  51.1    56.7 .00071  .36583E-02  .70448E-02 1.00   493.
 14  5.58   -.01  407.    283.37    -123.54     178.8  51.1 1069.  1084.8    33.4  51.1    61.0 .00037  .16829E-02  .65498E-02 1.00   117.
 15  5.75   -.01  437.    283.37    -154.02     183.2  51.1 1101.  1117.6    33.8  51.1    61.2 .00036  .54979E-03  .65329E-02 1.00    37.
 16  6.05    .00  468.    283.37    -184.50     190.9  51.1 1158.  1175.2    34.4  51.1    61.6 .00034  .14514E-03  .64816E-02 1.00     9.
 17  6.11    .00  498.    283.37    -214.98     192.6  51.1 1171.  1187.6    34.5  51.1    61.6 .00034  .29485E-04  .64740E-02 1.00     2.
 18  6.16    .00  529.    283.37    -245.46     193.9  51.1 1180.  1197.2    34.6  51.1    61.7 .00033  .47092E-05  .64682E-02 1.00     0.
 19  6.19    .00  559.    283.37    -275.94     194.6  51.1 1186.  1202.7    34.7  51.1    61.7 .00033  .58889E-06  .64649E-02 1.00     0.
 20  6.21    .00  590.    283.37    -306.42     195.1  51.1 1190.  1206.9    34.7  51.1    61.7 .00033  .57797E-07  .64624E-02 1.00     0.
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Figure 7-3 (Page 13 of 14)

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21  6.23     .00  620.    283.37    -336.90      195.5  51.1 1193. 1209.6    34.7  51.1     61.8 .00033  .44447E-08  .64608E-02 1.00     0.
22  6.27     .00  651.    283.37    -367.38      196.6  51.1 1201. 1217.8    34.8  51.1     61.8 .00033  .27324E-09  .64559E-02 1.00     0.
23  6.29     .00  681.    283.37    -397.86      197.1  51.1 1205. 1222.0    34.9  51.1     61.8 .00033  .13092E-10  .64535E-02 1.00     0.
        WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77   1 22

------------------------------------------------------------------------------------------------------------------------------------

CASE-HOUR #   12           YEAR, DAY, HOUR: 77   1 22
              WIND       MIXING                    AIR       TURB.       TURB.       VPTG,       VPTG,      DELTA      WSPD       WIND
   WIND     SPEED #1    HEIGHT    STABILITY     TEMP    INTENSITY  INTENSITY     PLUME       HCRIT      THETA    PROFILE    SPEED #2
DIRECTION   (M/SEC)       (M)        CLASS        (K)        (Y)        (Z)      (DEG K/M)  (DEG K/M)  (DEG/M)   EXPONENT    (M/SEC)

   220.       4.00       9999.         6        293.15     .0400*     .0160*      .0400       .0060      .4000     -.3000      12.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =   547.89 M
UTOP =  1.89 M/SEC,    FLUX =     254.59 M**4/S**3,  FINAL RISE =  120.95 M,  DISTANCE TO FINAL RISE =   106.90 M,  PEN. FRAC. =  .00

                         HT                                                                                    CONVENTIONAL REFLECTION
                       ABOVE  PLUME HT   PLUME HT           SIGMA-Y                        SIGMA-Z          HORIZ.   VERTICAL    VERTICAL          CHI
                       STACK  BEFORE   CORRECTED                                                             DIST.      DIST.       DIST.
REC    X       Y       BASE   TERRAIN  BY TERRAIN   AMBIENT BUOY  SHEAR   TOTAL  AMBIENT BUOY    TOTAL  FACTOR     FACTOR      FACTOR             (UG/
 #   (KM)    (KM)      (M)      (M)        (M)         (M)    (M)    (M)     (M)     (M)    (M)      (M)   (1/M)      (1/M)       (1/M)       R  M**3)

  1  3.26   -1.39   615.    242.87    -371.92      113.4  38.2  469.   483.6    26.4  38.2     46.5 .00001  .21085E-15  .86755E-02 1.01     0.
  4   .82     .00   102.    242.87     140.76       31.7  38.2  118.   128.1    10.6  38.2     39.7 .00311  .37210E-04  .10054E-01 1.00    61.
  5   .99     .00   133.    242.87     110.28       37.9  38.2  143.   152.4    12.2  38.2     40.2 .00262  .45785E-03  .99340E-02 1.00   634.
  6  1.25     .00   163.    242.87      79.80       47.1  38.2  179.   189.3    14.5  38.2     40.9 .00211  .29117E-02  .97547E-02 1.00  3247.
  7  1.32     .00   194.    242.87      49.32       49.6  38.2  189.   199.6    15.1  38.2     41.1 .00200  .94529E-02  .97060E-02 1.0010004.
  8  1.49     .00   224.    242.87      18.84       55.6  38.2  214.   224.3    16.5  38.2     41.6 .00178  .17296E-01  .95955E-02 1.00  9035.
  9  1.70     .00   255.    242.87     -11.64       62.7  38.2  243.   254.3    18.0  38.2     42.3 .00157  .18175E-01  .94542E-02 1.00  7850.
 10  2.04     .00   285.    242.87     -42.12       74.3  38.2  292.   304.1    20.2  38.2     43.3 .00131  .11481E-01  .92251E-02 1.00  6407.
 11  2.22     .00   315.    242.87     -72.60       80.4  38.2  319.   331.0    21.3  38.2     43.8 .00121  .46100E-02  .91246E-02 1.00  2941.
 12  2.51     .00   346.    242.87    -103.08       89.6  38.2  360.   372.6    22.9  38.2     44.6 .00107  .12343E-02  .89908E-02 1.00   700.
 13  2.86     .00   376.    242.87    -133.56      100.9  38.2  411.   424.4    24.6  38.2     45.5 .00094  .23562E-03  .87709E-02 1.00   117.
 14  5.58    -.01   407.    242.87    -164.04      178.8  38.2  801.   821.2    33.4  38.2     50.8 .00049  .84955E-04  .78603E-02 1.00    22.
 15  5.75    -.01   437.    242.87    -194.52      183.2  38.2  825.   846.0    33.8  38.2     51.0 .00047  .10890E-04  .78242E-02 1.00     3.
 16  6.05     .00   468.    242.87    -225.00      190.9  38.2  868.   889.4    34.4  38.2     51.4 .00045  .10822E-05  .77643E-02 1.00     0.
 17  6.11     .00   498.    242.87    -255.48      192.6  38.2  877.   898.8    34.5  38.2     51.5 .00044  .70648E-07  .77564E-02 1.00     0.
 18  6.16     .00   529.    242.87    -285.96      193.9  38.2  884.   906.0    34.6  38.2     51.6 .00044  .32762E-08  .77549E-02 1.00     0.
 19  6.19     .00   559.    242.87    -316.44      194.6  38.2  888.   910.1    34.7  38.2     51.6 .00044  .10673E-09  .77629E-02 1.00     0.
 20  6.21     .00   590.    242.87    -346.92      195.1  38.2  891.   913.3    34.7  38.2     51.6 .00044  .24605E-11  .77799E-02 1.01     0.
 21  6.23     .00   620.    242.87    -377.40      195.5  38.2  893.   915.3    34.7  38.2     51.7 .00044  .39983E-13  .78095E-02 1.01     0.
 22  6.27     .00   651.    242.87    -407.88      196.6  38.2  899.   921.5    34.8  38.2     51.7 .00043  .48206E-15  .78493E-02 1.02     0.
 23  6.29     .00   681.    242.87    -438.36      197.1  38.2  903.   924.7    34.9  38.2     51.7 .00043  .40371E-17  .77093E-02 1.00     0.
```

Figure 7-3 (Page 14 of 14)

```
     POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30       LEVEL 851125


TOPVAL


          LP   NH   NM    DAYSIN     HOURIN

           3    1    5        0.         0.


               NR   RFACT

               26  1000000.
```

Figure 7-4 ANALYSIS Output from Sample Run

```
POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30       LEVEL 851125

TOP    5 CONCENTRATIONS OF  3-HOUR AVERAGES FOR     12. HOURS

RECEPTOR     I    TOP    1 I    TOP    2 I    TOP    3 I    TOP    4 I    TOP    5 I
-------------+-------------+-------------+-------------+-------------+-------------+
    1        I    50.3323 I    21.6594 I     7.5413 I     4.0747 I      .0000 I
DAY/HOUR     I    1      3 I    1      6 I    1     12 I    1      9 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
    2        I      .1517 I      .0000 I      .0000 I      .0000 I      .0000 I
DAY/HOUR     I    1      3 I    0      0 I    0      0 I    0      0 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
    3        I      .0000 I      .0000 I      .0000 I      .0000 I      .0000 I
DAY/HOUR     I    0      0 I    0      0 I    0      0 I    0      0 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
    4        I   136.1632 I    83.8155 I    35.7903 I    35.5793 I      .0000 I
DAY/HOUR     I    1      3 I    1      6 I    1     12 I    1      9 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
    5        I   269.7798 I   245.5842 I   149.0348 I   126.6413 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      3 I    1      6 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
    6        I  1262.2043 I   920.3296 I   203.1556 I   187.3455 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
    7        I  3819.4370 I  2044.3994 I   272.3083 I   219.7519 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
    8        I  3900.0288 I  1883.6309 I   359.3069 I   260.5178 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
    9        I  3571.7375 I  1657.3567 I   431.1162 I   292.3269 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
   10        I  3074.3245 I  1380.3132 I   465.0286 I   306.3379 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
   11        I  1835.7200 I  1269.6245 I   455.6624 I   303.7664 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
   12        I   983.9363 I   717.1672 I   402.2705 I   283.5063 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
   13        I   534.7805 I   452.8689 I   346.2053 I   246.5181 I      .0000 I
DAY/HOUR     I    1     12 I    1      9 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
   14        I   252.3053 I   203.3554 I   195.1604 I   102.6576 I      .0000 I
DAY/HOUR     I    1      9 I    1     12 I    1      6 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
   15        I   210.7275 I   180.0722 I   165.4961 I    98.4878 I      .0000 I
DAY/HOUR     I    1      9 I    1      6 I    1     12 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
   16        I   185.5509 I   160.9107 I   147.5036 I    91.1588 I      .0000 I
DAY/HOUR     I    1      9 I    1      6 I    1     12 I    1      3 I    0      0 I
-------------+-------------+-------------+-------------+-------------+-------------+
```

Figure 7-4 (Page 2 of 14)

```
POST-PROCESSING ANALYSIS PROGRAM      VERSION 2.30      LEVEL 851125

TOP    5 CONCENTRATIONS OF  3-HOUR AVERAGES FOR    12. HOURS

RECEPTOR    I   TOP    1 I   TOP    2 I   TOP    3 I   TOP    4 I   TOP    5 I
------------+------------+------------+------------+------------+------------+
   17       I  175.6718 I  142.9572 I  142.1077 I   90.1069 I     .0000 I
DAY/HOUR    I    1    9 I    1    6 I    1   12 I    1    3 I    0    0 I
------------+------------+------------+------------+------------+------------+
   18       I  162.0896 I  160.4165 I  112.1220 I   88.1413 I     .0000 I
DAY/HOUR    I    1    9 I    1    6 I    1   12 I    1    3 I    0    0 I
------------+------------+------------+------------+------------+------------+
   19       I  172.4082 I  141.5300 I   85.5362 I   72.4911 I     .0000 I
DAY/HOUR    I    1    9 I    1    6 I    1    3 I    1   12 I    0    0 I
------------+------------+------------+------------+------------+------------+
   20       I  159.9876 I  158.0484 I   85.3923 I   43.2357 I     .0000 I
DAY/HOUR    I    1    6 I    1    9 I    1    3 I    1   12 I    0    0 I
------------+------------+------------+------------+------------+------------+
   21       I  169.5784 I  121.0291 I   85.5868 I   23.7747 I     .0000 I
DAY/HOUR    I    1    9 I    1    6 I    1    3 I    1   12 I    0    0 I
------------+------------+------------+------------+------------+------------+
   22       I  172.5266 I  148.1988 I   85.3331 I   12.0263 I     .0000 I
DAY/HOUR    I    1    9 I    1    6 I    1    3 I    1   12 I    0    0 I
------------+------------+------------+------------+------------+------------+
   23       I  163.8979 I  154.1504 I   85.6801 I    5.6163 I     .0000 I
DAY/HOUR    I    1    6 I    1    9 I    1    3 I    1   12 I    0    0 I
------------+------------+------------+------------+------------+------------+
   24       I     .0000 I     .0000 I     .0000 I     .0000 I     .0000 I
DAY/HOUR    I    0    0 I    0    0 I    0    0 I    0    0 I    0    0 I
------------+------------+------------+------------+------------+------------+
   25       I     .0000 I     .0000 I     .0000 I     .0000 I     .0000 I
DAY/HOUR    I    0    0 I    0    0 I    0    0 I    0    0 I    0    0 I
------------+------------+------------+------------+------------+------------+
   26       I     .0000 I     .0000 I     .0000 I     .0000 I     .0000 I
DAY/HOUR    I    0    0 I    0    0 I    0    0 I    0    0 I    0    0 I
------------+------------+------------+------------+------------+------------+
```

Figure 7-4 (Page 3 of 14)

```
POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125

        TOP 25 HIGHEST AND HIGHEST, SECOND-HIGHEST CONCENTRATIONS

                      HIGHEST                    HIGHEST, SECOND-HIGHEST

RANK       RECEPTOR   CONCENTRATION              RECEPTOR   CONCENTRATION

  1            8        3900.029                     7        2044.399

  2            7        3819.437                     8        1883.631

  3            9        3571.738                     9        1657.357

  4           10        3074.324                    10        1380.313

  5           11        1835.720                    11        1269.625

  6            6        1262.204                     6         920.330

  7           12         983.936                    12         717.167

  8           13         534.781                    13         452.869

  9            5         269.780                     5         245.584

 10           14         252.305                    14         203.355

 11           15         210.727                    15         180.072

 12           16         185.551                    16         160.911

 13           17         175.672                    18         160.417

 14           22         172.527                    20         158.048

 15           19         172.408                    23         154.150

 16           21         169.578                    22         148.199

 17           23         163.898                    17         142.957

 18           18         162.090                    19         141.530

 19           20         159.988                    21         121.029

 20            4         136.163                     4          83.816

 21            1          50.332                     1          21.659

 22            2            .152                    22            .000

 23           23            .000                    23            .000

 24           24            .000                    24            .000

 25           25            .000                    25            .000
```

Figure 7-4 (Page 4 of 14)

```
    POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125


CUMFREQ


      HOURIN    DAYSIN    RFACT        NHR  NLEV  NR
          0.        0.  1000000.         1    6   26

  CUMULATIVE LEVELS:
            100.0     200.0     500.0    1000.0    2000.0    3000.0
```

Figure 7-4 (Page 5 of 14)

```
     POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30     LEVEL 851125

   CUMULATIVE FREQUENCIES OF    1-HOUR AVERAGES FOR   12. OBSERVATIONS

RECEPTOR   I   LEVEL   I   LEVEL   I   LEVEL   I   LEVEL   I   LEVEL   I
           I     100.0I      200.0I      500.0I     1000.0I     2000.0I
           +-----------+-----------+-----------+-----------+-----------+
    1      I   1.0000 I     .0000 I     .0000 I     .0000 I     .0000 I
CUM FREQ   I   1.0000 I    1.0000 I    1.0000 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
    2      I   1.0000 I     .0000 I     .0000 I     .0000 I     .0000 I
CUM FREQ   I   1.0000 I    1.0000 I    1.0000 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
    3      I   1.0000 I     .0000 I     .0000 I     .0000 I     .0000 I
CUM FREQ   I   1.0000 I    1.0000 I    1.0000 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
    4      I    .8333 I     .0833 I     .0833 I     .0000 I     .0000 I
CUM FREQ   I    .8333 I     .9167 I    1.0000 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
    5      I    .5000 I     .2500 I     .0833 I     .1667 I     .0000 I
CUM FREQ   I    .5000 I     .7500 I     .8333 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
    6      I    .2500 I     .2500 I     .3333 I     .0000 I     .0000 I
CUM FREQ   I    .2500 I     .5000 I     .8333 I     .8333 I     .8333 I
           +-----------+-----------+-----------+-----------+-----------+
    7      I    .2500 I     .0000 I     .5000 I     .0000 I     .0833 I
CUM FREQ   I    .2500 I     .2500 I     .7500 I     .7500 I     .8333 I
           +-----------+-----------+-----------+-----------+-----------+
    8      I    .1667 I     .0833 I     .2500 I     .2500 I     .0833 I
CUM FREQ   I    .1667 I     .2500 I     .5000 I     .7500 I     .8333 I
           +-----------+-----------+-----------+-----------+-----------+
    9      I    .0833 I     .1667 I     .2500 I     .1667 I     .1667 I
CUM FREQ   I    .0833 I     .2500 I     .5000 I     .6667 I     .8333 I
           +-----------+-----------+-----------+-----------+-----------+
   10      I    .0000 I     .2500 I     .2500 I     .1667 I     .1667 I
CUM FREQ   I    .0000 I     .2500 I     .5000 I     .6667 I     .8333 I
           +-----------+-----------+-----------+-----------+-----------+
   11      I    .0000 I     .0833 I     .4167 I     .1667 I     .1667 I
CUM FREQ   I    .0000 I     .0833 I     .5000 I     .6667 I     .8333 I
           +-----------+-----------+-----------+-----------+-----------+
   12      I    .0000 I     .0833 I     .4167 I     .2500 I     .2500 I
CUM FREQ   I    .0000 I     .0833 I     .5000 I     .7500 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
   13      I    .0000 I     .1667 I     .6667 I     .1667 I     .0000 I
CUM FREQ   I    .0000 I     .1667 I     .8333 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
   14      I    .2500 I     .3333 I     .4167 I     .0000 I     .0000 I
CUM FREQ   I    .2500 I     .5833 I    1.0000 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
   15      I    .5000 I     .1667 I     .3333 I     .0000 I     .0000 I
CUM FREQ   I    .5000 I     .6667 I    1.0000 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
   16      I    .5000 I     .1667 I     .3333 I     .0000 I     .0000 I
CUM FREQ   I    .5000 I     .6667 I    1.0000 I    1.0000 I    1.0000 I
           +-----------+-----------+-----------+-----------+-----------+
```

Figure 7-4 (Page 6 of 14)

```
POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30        LEVEL 851125

  CUMULATIVE FREQUENCIES OF     1-HOUR AVERAGES FOR   12. OBSERVATIONS

RECEPTOR    I    LEVEL   I   LEVEL   IAVG:# OBS= I
            I     3000.0I **********I        12.0I
            +-----------+-----------+------------+
     1      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I    20.9019 I
            +-----------+-----------+------------+
     2      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I      .0379 I
            +-----------+-----------+------------+
     3      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I      .0000 I
            +-----------+-----------+------------+
     4      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I    72.8370 I
            +-----------+-----------+------------+
     5      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I   197.7600 I
            +-----------+-----------+------------+
     6      I    .0833 I     .0833 I      .0000 I
 CUM FREQ   I    .9167 I    1.0000 I   643.2588 I
            +-----------+-----------+------------+
     7      I    .0000 I     .1667 I      .0000 I
 CUM FREQ   I    .8333 I    1.0000 I  1588.9744 I
            +-----------+-----------+------------+
     8      I    .0000 I     .1667 I      .0000 I
 CUM FREQ   I    .8333 I    1.0000 I  1600.8711 I
            +-----------+-----------+------------+
     9      I    .0000 I     .1667 I      .0000 I
 CUM FREQ   I    .8333 I    1.0000 I  1488.1345 I
            +-----------+-----------+------------+
    10      I    .0000 I     .1667 I      .0000 I
 CUM FREQ   I    .8333 I    1.0000 I  1306.5010 I
            +-----------+-----------+------------+
    11      I    .0833 I     .0833 I      .0000 I
 CUM FREQ   I    .9167 I    1.0000 I   966.1931 I
            +-----------+-----------+------------+
    12      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I   596.7200 I
            +-----------+-----------+------------+
    13      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I   395.0935 I
            +-----------+-----------+------------+
    14      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I   188.3696 I
            +-----------+-----------+------------+
    15      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I   163.6959 I
            +-----------+-----------+------------+
    16      I    .0000 I     .0000 I      .0000 I
 CUM FREQ   I   1.0000 I    1.0000 I   146.2810 I
            +-----------+-----------+------------+
```

Figure 7-4 (Page 7 of 14)

```
     POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125

    CUMULATIVE FREQUENCIES OF     1-HOUR AVERAGES FOR   12. OBSERVATIONS

  RECEPTOR    I    LEVEL   I   LEVEL   I   LEVEL   I   LEVEL   I   LEVEL   I
              I      100.0I      200.0I      500.0I     1000.0I     2000.0I
              +-----------+-----------+-----------+-----------+-----------+
     17       I     .5000 I     .1667 I     .3333 I     .0000 I     .0000 I
  CUM FREQ    I     .5000 I     .6667 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     18       I     .5000 I     .1667 I     .3333 I     .0000 I     .0000 I
  CUM FREQ    I     .5000 I     .6667 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     19       I     .5000 I     .2500 I     .2500 I     .0000 I     .0000 I
  CUM FREQ    I     .5000 I     .7500 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     20       I     .5000 I     .2500 I     .2500 I     .0000 I     .0000 I
  CUM FREQ    I     .5000 I     .7500 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     21       I     .5833 I     .2500 I     .1667 I     .0000 I     .0000 I
  CUM FREQ    I     .5833 I     .8333 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     22       I     .5833 I     .1667 I     .2500 I     .0000 I     .0000 I
  CUM FREQ    I     .5833 I     .7500 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     23       I     .5833 I     .1667 I     .2500 I     .0000 I     .0000 I
  CUM FREQ    I     .5833 I     .7500 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     24       I    1.0000 I     .0000 I     .0000 I     .0000 I     .0000 I
  CUM FREQ    I    1.0000 I    1.0000 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     25       I    1.0000 I     .0000 I     .0000 I     .0000 I     .0000 I
  CUM FREQ    I    1.0000 I    1.0000 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
     26       I    1.0000 I     .0000 I     .0000 I     .0000 I     .0000 I
  CUM FREQ    I    1.0000 I    1.0000 I    1.0000 I    1.0000 I    1.0000 I
              +-----------+-----------+-----------+-----------+-----------+
```

Figure 7-4 (Page 8 of 14)

```
   POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125

  CUMULATIVE FREQUENCIES OF     1-HOUR AVERAGES FOR   12. OBSERVATIONS
RECEPTOR    I   LEVEL   I   LEVEL   IAVG:# OBS= I
            I    3000.0I ***********I       12.0I
            +-----------+-----------+-----------+
    17      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I  137.7110 I
            +-----------+-----------+-----------+
    18      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I  130.6924 I
            +-----------+-----------+-----------+
    19      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I  117.9913 I
            +-----------+-----------+-----------+
    20      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I  111.6660 I
            +-----------+-----------+-----------+
    21      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I   99.9922 I
            +-----------+-----------+-----------+
    22      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I  104.5212 I
            +-----------+-----------+-----------+
    23      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I  102.3362 I
            +-----------+-----------+-----------+
    24      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I     .0000 I
            +-----------+-----------+-----------+
    25      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I     .0000 I
            +-----------+-----------+-----------+
    26      I     .0000 I     .0000 I     .0000 I
 CUM FREQ   I    1.0000 I    1.0000 I     .0000 I
            +-----------+-----------+-----------+
```

Figure 7-4 (Page 9 of 14)

```
    POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125


PEAK


         NHR       THR     HOURIN    DAYSIN       NH

           3     1300.        0.        0.         1


          RFACT   UNITS        LPRINT   NR  SCALE

         1000000.                   T   26        1.
```

Figure 7-4 (Page 10 of 14)

```
     POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30       LEVEL 851125

  1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  9  AT RECEPTOR    7
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD        TOTAL                 MIX  DIR  STAB SPD
     1        36.6827               1000  220    4    3
     2       315.7881                450  220    4   15
     3      5780.7266               9999  220    5    2
 MEAN       2044.3992

  1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  9  AT RECEPTOR    8
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD        TOTAL                 MIX  DIR  STAB SPD
     1        61.9990               1000  220    4    3
     2       583.2815                450  220    4   15
     3      5005.6133               9999  220    5    2
 MEAN       1883.6313

  1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  9  AT RECEPTOR    9
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD        TOTAL                 MIX  DIR  STAB SPD
     1        98.6686               1000  220    4    3
     2       597.5732                450  220    4   15
     3      4275.8281               9999  220    5    2
 MEAN       1657.3567

  1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  9  AT RECEPTOR   10
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD        TOTAL                 MIX  DIR  STAB SPD
     1       147.6522               1000  220    4    3
     2       596.3550                450  220    4   15
     3      3396.9314               9999  220    5    2
 MEAN       1380.3130

  1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR    7
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD        TOTAL                 MIX  DIR  STAB SPD
     1       418.7693               9999  220    5    4
     2      1035.9919               9999  220    6    3
     3     10003.5508               9999  220    6    4
 MEAN       3819.4373

  1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR    8
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD        TOTAL                 MIX  DIR  STAB SPD
     1       765.3591               9999  220    5    4
     2      1899.4578               9999  220    6    3
     3      9035.2695               9999  220    6    4
 MEAN       3900.0288

  1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR    9
 **** CONCENTRATIONS (uG/M**3 )          WEATHER
 RECORD        TOTAL                 MIX  DIR  STAB SPD
     1      1205.0320               9999  220    5    4
     2      1659.7881               9999  220    6    3
     3      7850.3945               9999  220    6    4
 MEAN       3571.7380
```

Figure 7-4 (Page 11 of 14)

```
POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30       LEVEL 851125

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR  10
**** CONCENTRATIONS (uG/M**3 )           WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1     1448.5771               9999  220    5    4
    2     1367.1082               9999  220    6    3
    3     6407.2852               9999  220    6    4
MEAN      3074.3235

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR  11
**** CONCENTRATIONS (uG/M**3 )           WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1     1319.3792               9999  220    5    4
    2     1246.4692               9999  220    6    3
    3     2941.3101               9999  220    6    4
MEAN      1835.7195
```

Figure 7-4 (Page 12 of 14)

```
      POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125

TOTAL MAXIMUM CONCENTRATIONS (uG/M**3 ) FOR     4 ( 3-HOUR) AVERAGING PERIOD(S)

 RECEP +    1    +    2    +    3    +    4    +    5    +    6    +    7    +    8    +
-------+---------+---------+---------+---------+---------+---------+---------+---------+
  CONC !  50.332!     .152!     .000! 136.163! 269.780!1262.204!3819.437!3900.029!
DAY/HR !   1   3!   1   3!   0   0!   1   3!   1  12!   1  12!   1  12!   1  12!

 RECEP +    9    +   10    +   11    +   12    +   13    +   14    +   15    +   16    +
-------+---------+---------+---------+---------+---------+---------+---------+---------+
  CONC !3571.738!3074.323!1835.719! 983.936! 534.781! 252.305! 210.727! 185.551!
DAY/HR !   1  12!   1  12!   1  12!   1  12!   1  12!   1   9!   1   9!   1   9!

 RECEP +   17    +   18    +   19    +   20    +   21    +   22    +   23    +   24    +
-------+---------+---------+---------+---------+---------+---------+---------+---------+
  CONC ! 175.672! 162.090! 172.408! 159.988! 169.578! 172.527! 163.898!     .000!
DAY/HR !   1   9!   1   9!   1   9!   1   6!   1   9!   1   9!   1   6!   0   0!

 RECEP +   25    +   26    +
-------+---------+---------+
  CONC !     .000!     .000!
DAY/HR !   0   0!   0   0!
```

Figure 7-4 (Page 13 of 14)

```
      POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30       LEVEL 851125

      NUMBER OF  3-HOUR AVERAGES ABOVE  1300.0000 uG/M**3  FOR     12 HOURS

RECEPTORS:
-------+---------+---------+---------+---------+---------+---------+---------+---------+
  1-  8!    0    !    0    !    0    !    0    !    0    !    0    !    2    !    2    !
-------!---------!---------!---------!---------!---------!---------!---------!---------!
  9- 16!    2    !    2    !    1    !    0    !    0    !    0    !    0    !    0    !
-------!---------!---------!---------!---------!---------!---------!---------!---------!
 17- 24!    0    !    0    !    0    !    0    !    0    !    0    !    0    !    0    !
-------!---------!---------!---------!---------!---------!---------!---------!---------!
 25- 26!    0    !    0    !
-------!---------!---------!
```

Figure 7-4 (Page 14 of 14)

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APPENDIX A

SOURCE CODE LISTINGS FOR PREPRO

```
C*******************************************************
C       PROGRAM PREPRO
C
C       THIS PROGRAM READS IN A FILE PREPARED BY RAMMET AND EXTRACTS
C       WIND DIRECTION, WIND SPEED, STABILITY CLASS, MIXING HEIGHTS,
C       AND TEMPERATURE.  THE WIND DIRECTION IS OBTAINED BY ADDING
C       180 DEGREES TO THE RAMMET INPUT FLOW VECTOR.  INPUT DATA
C       IS READ FROM CHANNEL 2 AND OUTPUT DATA IS WRITTEN TO CHANNEL 3.
C       INFORMATION ON THE NUMBER OF DAYS TO SKIP AND THE NUMBER OF
C       DAYS TO EXTRACT FROM THE BINARY MET FILE ARE READ IN FROM
C       CHANNEL 1.
C
C*******************************************************
C
C       ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       PREPRO    VERSION 3.00    LEVEL 821010
C
C*******************************************************


      INTEGER  IST(24),IYEAR,JYEAR,JMONTH,IDD
      REAL U(24),FLOW(24),FLOWR(24)
      REAL TEMP(24),DMX(2,24),RDAY,STAB(24)
C
C     READ FROM CHANNEL 1 TO OBTAIN SKIP AND EXTRACT COUNTS
C
      READ(1,1) ISKIP,IEXTR
    1 FORMAT(I5,I5)

      READ(2,END=9000) IDD,IYEAR,IDD,IYEAR  @ READ AND DISCARD HEADER
      IF(ISKIP.LT.1) GO TO 1500
      DO 1000 KSKIP=1,ISKIP
      READ(2,END=9000)JYEAR,JMONTH,RDAY,IST,U,TEMP,FLOW,FLOWR,DMX
 1000 CONTINUE
 1500 DO 5000 KDAYS=1,IEXTR
      READ(2,END=9000)JYEAR,JMONTH,RDAY,IST,U,TEMP,FLOW,FLOWR,DMX
      IDAY=INT(RDAY+.001)
      DO 4000 K=1,24
      U(K)=U(K)/0.44707      @ SPEED IN MILES PER HOUR
      TEMP(K)=1.8*TEMP(K)-459.67    @ TEMPERATURE IN DEG F
      STAB(K)=FLOAT(IST(K))
      FLOWR(K)=FLOWR(K)+180.0  @ METEOROLOGICAL CONVENTION FOR WIND DIR
      IF(FLOWR(K).LE.360.0) GO TO 4000
      FLOWR(K)=FLOWR(K)-360.0
 4000 CONTINUE
      WRITE(3,2)(JYEAR,IDAY,I,FLOWR(I),U(I),DMX(1,I),STAB(I),TEMP(I),
     X I=1,24)
    2 FORMAT(I2,I3,I2,1X,F6.0,F6.1,F6.0,F6.0,F6.1)
 5000 CONTINUE
C
 9000 CONTINUE
C
      STOP
      END
```

APPENDIX B

SOURCE CODE LISTINGS FOR RTDM

```
C***********************************************************************
C
C       MAIN PROGRAM FOR RTDM
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C
C***********************************************************************
C
      COMMON /HEAD/NPAGE,NLINE
      REAL KEYS(5),NINES
      DATA KEYS /'PARA','POIN','STAC','TERR','EXEC'/
      DATA NINES/'9999'/,ENDJ/'ENDJ'/
C
      NPAGE = 0
      NLINE = 0
      IPARAM = 0
      IPOINT = 0
      ISTACK = 0
      CALL PAGE
C
      CALL BLKFIX    @ INITIALIZE AND SET UP COMMON BLOCKS
   30 READ(5,1000)WORD
 1000 FORMAT(A4)
      IF(WORD.EQ.NINES)GO TO 30
      IF(WORD.EQ.ENDJ)GO TO 9000
      DO 50 I=1,5
      IF(WORD.EQ.KEYS(I))GO TO 70
   50 CONTINUE
      WRITE(6,2000) WORD
 2000 FORMAT(' KEYWORD NOT AMONG THOSE EXPECTED: ',A4)
      GO TO 9000
   70 K=I
C
      GO TO (100,200,300,400,500), K
C
C       'PARAMETERS'
C
  100 CALL INPAR
      CALL WRPAR
      IPARAM = 1
      GO TO 30
C
C       'POINTS'
C
  200 IF(IPARAM.EQ.1.AND.ISTACK.EQ.1) GO TO 250
      WRITE(6,1)
    1 FORMAT(//,'  POINTS KEYWORD MUST FOLLOW PARAMETERS AND STACKS.')
      GO TO 9000
  250 CALL POINTS
      IPOINT = 1
      GO TO 30
C
C       'STACKS'
C
```

```
  300 IF(IPARAM.EQ.1) GO TO 350                                         RTD00580
      WRITE(6,2)                                                        RTD00590
    2 FORMAT(//,'  STACKS KEYWORD MUST FOLLOW PARAMETERS.')             RTD00600
      GO TO 9000                                                        RTD00610
  350 CALL STAKS                                                        RTD00620
      ISTACK = 1                                                        RTD00630
      GO TO 30                                                          RTD00640
C                                                                       RTD00650
C     'TERRAIN'                                                         RTD00660
C                                                                       RTD00670
  400 IF(IPARAM.EQ.1.AND.ISTACK.EQ.1.AND.IPOINT.EQ.1) GO TO 450         RTD00680
      WRITE(6,3)                                                        RTD00690
    3 FORMAT(//,'  TERRAIN KEYWORD MUST FOLLOW PARAMETERS, STACKS, ',   RTD00700
     X'AND POINTS.')                                                    RTD00710
      GO TO 9000                                                        RTD00720
  450 CALL TERAIN                                                       RTD00730
      GO TO 30                                                          RTD00740
C                                                                       RTD00750
C     'EXECUTE'                                                         RTD00760
C                                                                       RTD00770
  500 IF(IPARAM.EQ.1.AND.ISTACK.EQ.1.AND.IPOINT.EQ.1) GO TO 550         RTD00780
      WRITE(6,4)                                                        RTD00790
    4 FORMAT(//,'  EXECUTE KEYWORD MUST FOLLOW PARAMETERS, STACKS, ',   RTD00800
     X'AND POINTS.')                                                    RTD00810
      GO TO 9000                                                        RTD00820
  550 CALL RTXEQ                                                        RTD00830
      GO TO 9000                                                        RTD00840
C                                                                       RTD00850
C     'ENDJOB'                                                          RTD00860
C                                                                       RTD00870
 9000 CALL PAGE                                                         RTD00880
      STOP                                                              RTD00890
      END                                                               RTD00900
      SUBROUTINE BLKFIX
C
C***********************************************************************
C
C     BLOCK DATA HOLDING DEFAULTS FOR RTDM COMMON BLOCKS
C
C     ERT, INC.
C     696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C     RTDM
C
C***********************************************************************
C
C
C
C
C-------------  PARAMETERS  -------------------------------------------
C
      COMMON /PR001/ HSCALE
C
C------------------------------
C
      COMMON /PR002/ VSCALE
C
C------------------------------
C
      COMMON /PR003/ USCALE
C
C------------------------------
C
      COMMON /PR004/ ZWIND1,ZWIND2,IDILUT,ZA
C
C------------------------------
C
      COMMON /PR005/ EXPON(6)
C
C------------------------------
C
      COMMON /PR006/ ICOEF
C
C------------------------------
C
      DIMENSION AY(6,3),BY(6,3),CY(6,3)
      COMMON /PR007/ AY, BY, CY, XY1,XY2
C
C------------------------------
C
      DIMENSION AZ(6,3),BZ(6,3),CZ(6,3)
      COMMON /PR008/ AZ, BZ, CZ, XZ1,XZ2
C
C------------------------------
C
      COMMON /PR009/ IPPP,PPVPTG
C
C------------------------------
C
      COMMON /PR010/ IBUOY,ALPHA
```

```
C                                                                       BLK00580
C-------------------------------                                        BLK00590
C                                                                       BLK00600
      COMMON /PR011/ IDMX                                               BLK00610
C                                                                       BLK00620
C-------------------------------                                        BLK00630
C                                                                       BLK00640
      COMMON /PR012/ ITRANS                                             BLK00650
C                                                                       BLK00660
C-------------------------------                                        BLK00670
C                                                                       BLK00680
      COMMON /PR013/ TERCOR(6)                                          BLK00690
C                                                                       BLK00700
C-------------------------------                                        BLK00710
C                                                                       BLK00720
      COMMON /PR014/ RVPTG(2)                                           BLK00730
C                                                                       BLK00740
C-------------------------------                                        BLK00750
C                                                                       BLK00760
      COMMON /PR015/ ITIPD                                              BLK00770
C                                                                       BLK00780
C-------------------------------                                        BLK00790
C                                                                       BLK00800
      COMMON /PR016/ IY                                                 BLK00810
C                                                                       BLK00820
C-------------------------------                                        BLK00830
C                                                                       BLK00840
      COMMON /PR017/ IZ                                                 BLK00850
C                                                                       BLK00860
C-------------------------------                                        BLK00870
C                                                                       BLK00880
      COMMON /PR018/ IRVPTG                                             BLK00890
C                                                                       BLK00900
C-------------------------------                                        BLK00910
C                                                                       BLK00920
      COMMON /PR019/ IHVPTG                                             BLK00930
C                                                                       BLK00940
C-------------------------------                                        BLK00950
C                                                                       BLK00960
      COMMON /PR020/ ISHEAR,SHCOEF                                      BLK00970
C                                                                       BLK00980
C-------------------------------                                        BLK00990
C                                                                       BLK01000
      COMMON /PR021/ IEPS                                               BLK01010
C                                                                       BLK01020
C-------------------------------                                        BLK01030
C                                                                       BLK01040
      COMMON /PR022/ IREFL                                              BLK01050
C                                                                       BLK01060
C-------------------------------                                        BLK01070
C                                                                       BLK01080
      COMMON /PR023/ IHORIZ,SECTOR(6)                                   BLK01090
C                                                                       BLK01100
C-------------------------------                                        BLK01110
C                                                                       BLK01120
      COMMON /PR024/ IEMIS                                              BLK01130
C                                                                       BLK01140
```

```
C--------------------------------                                       BLK01150
C                                                                       BLK01160
      COMMON /PR025/ IVERB                                              BLK01170
C                                                                       BLK01180
C--------------------------------                                       BLK01190
C                                                                       BLK01200
C                                                                       BLK01210
C------------------------------------------------------------------     BLK01220
C               DEFAULT VALUES OF PARAMETERS                            BLK01230
C------------------------------------------------------------------     BLK01240
C                                                                       BLK01250
C--------------------------------- /PR001/                              BLK01260
C                                                                       BLK01270
      DATA HSCALE /1000./                                               BLK01280
C                                                                       BLK01290
C--------------------------------- /PR002/                              BLK01300
C                                                                       BLK01310
      DATA VSCALE /.3048/                                               BLK01320
C                                                                       BLK01330
C--------------------------------- /PR003/                              BLK01340
C                                                                       BLK01350
      DATA USCALE /.4471/                                               BLK01360
C                                                                       BLK01370
C--------------------------------- /PR004/                              BLK01380
C                                                                       BLK01390
      DATA ZWIND1 /10./,ZWIND2 /10./,IDILUT /0/,ZA/0.0/                 BLK01400
C                                                                       BLK01410
C--------------------------------- /PR005/                              BLK01420
C                                                                       BLK01430
      DATA EXPON /.09,.11,.12,.14,.20,.30/                              BLK01440
C                                                                       BLK01450
C--------------------------------- /PR006/                              BLK01460
C                                                                       BLK01470
      DATA ICOEF /3/                                                    BLK01480
C                                                                       BLK01490
C--------------------------------- /PR007/                              BLK01500
C                                                                       BLK01510
      DATA (AY(I,1),I=1,6)/0.40,0.36,0.34,0.32,0.31,0.31/               BLK01520
      DATA (BY(I,1),I=1,6)/0.91,0.86,0.82,0.78,0.71,0.71/               BLK01530
      DATA (CY(I,1),I=1,6)/0.0,0.0,0.0,0.0,0.0,0.0/                     BLK01540
      DATA (AY(I,2),I=1,6)/0.40,0.36,0.34,0.32,0.31,0.31/               BLK01550
      DATA (BY(I,2),I=1,6)/0.91,0.86,0.82,0.78,0.71,0.71/               BLK01560
      DATA (CY(I,2),I=1,6)/0.0,0.0,0.0,0.0,0.0,0.0/                     BLK01570
      DATA (AY(I,3),I=1,6)/0.40,0.36,0.34,0.32,0.31,0.31/               BLK01580
      DATA (BY(I,3),I=1,6)/0.91,0.86,0.82,0.78,0.71,0.71/               BLK01590
      DATA (CY(I,3),I=1,6)/0.0,0.0,0.0,0.0,0.0,0.0/                     BLK01600
      DATA XY1/1.E2/,XY2/1.E3/                                          BLK01610
C                                                                       BLK01620
C--------------------------------- /PR008/                              BLK01630
C                                                                       BLK01640
      DATA (AZ(I,1),I=1,6)/0.40,0.33,0.28,0.22,0.06,0.06/               BLK01650
      DATA (BZ(I,1),I=1,6)/0.91,0.86,0.82,0.78,0.71,0.71/               BLK01660
      DATA (CZ(I,1),I=1,6)/0.0,0.0,0.0,0.0,0.0,0.0/                     BLK01670
      DATA (AZ(I,2),I=1,6)/0.40,0.33,0.28,0.22,0.06,0.06/               BLK01680
      DATA (BZ(I,2),I=1,6)/0.91,0.86,0.82,0.78,0.71,0.71/               BLK01690
      DATA (CZ(I,2),I=1,6)/0.0,0.0,0.0,0.0,0.0,0.0/                     BLK01700
      DATA (AZ(I,3),I=1,6)/0.40,0.33,0.28,0.22,0.06,0.06/               BLK01710
      DATA (BZ(I,3),I=1,6)/0.91,0.86,0.82,0.78,0.71,0.71/               BLK01720
      DATA (CZ(I,3),I=1,6)/0.0,0.0,0.0,0.0,0.0,0.0/                     BLK01730
      DATA XZ1/1.E2/,XZ2/1.E3/                                          BLK01740
C                                                                       BLK01750
C-------------------------------- /PR009/                               BLK01760
C                                                                       BLK01770
      DATA IPPP /0/, PPVPTG /0.006/                                     BLK01780
C                                                                       BLK01790
C-------------------------------- /PR010/                               BLK01800
C                                                                       BLK01810
       DATA IBUOY /1/, ALPHA /3.16228/                                  BLK01820
C                                                                       BLK01830
C-------------------------------- /PR011/                               BLK01840
C                                                                       BLK01850
       DATA IDMX /1/                                                    BLK01860
C                                                                       BLK01870
C-------------------------------- /PR012/                               BLK01880
C                                                                       BLK01890
       DATA ITRANS /1/                                                  BLK01900
C                                                                       BLK01910
C-------------------------------- /PR013/                               BLK01920
C                                                                       BLK01930
      DATA TERCOR /0.5,0.5,0.5,0.5,0.5,0.5/                             BLK01940
C                                                                       BLK01950
C-------------------------------- /PR014/                               BLK01960
C                                                                       BLK01970
      DATA RVPTG /0.020,0.035/                                          BLK01980
C                                                                       BLK01990
C-------------------------------- /PR015/                               BLK02000
C                                                                       BLK02010
      DATA ITIPD /0/                                                    BLK02020
C                                                                       BLK02030
C-------------------------------- /PR016/                               BLK02040
C                                                                       BLK02050
      DATA IY /0/                                                       BLK02060
C                                                                       BLK02070
C-------------------------------- /PR017/                               BLK02080
C                                                                       BLK02090
      DATA IZ /0/                                                       BLK02100
C                                                                       BLK02110
C-------------------------------- /PR018/                               BLK02120
C                                                                       BLK02130
      DATA IRVPTG /0/                                                   BLK02140
C                                                                       BLK02150
C-------------------------------- /PR019/                               BLK02160
C                                                                       BLK02170
      DATA IHVPTG /0/                                                   BLK02180
C                                                                       BLK02190
C-------------------------------- /PR020/                               BLK02200
C                                                                       BLK02210
      DATA ISHEAR /0/, SHCOEF /0.17/                                    BLK02220
C                                                                       BLK02230
C-------------------------------- /PR021/                               BLK02240
C                                                                       BLK02250
      DATA IEPS /0/                                                     BLK02260
C                                                                       BLK02270
C-------------------------------- /PR022/                               BLK02280
```

```
C                                                                       BLK02290
      DATA IREFL /1/                                                    BLK02300
C                                                                       BLK02310
C-------------------------------- /PR023/                               BLK02320
C                                                                       BLK02330
      DATA IHORIZ /2/, SECTOR /6*22.5/                                  BLK02340
C                                                                       BLK02350
C-------------------------------- /PR024/                               BLK02360
C                                                                       BLK02370
      DATA IEMIS /0/                                                    BLK02380
C                                                                       BLK02390
C-------------------------------- /PR025/                               BLK02400
C                                                                       BLK02410
      DATA IVERB /0/                                                    BLK02420
C                                                                       BLK02430
C--------------------------------                                       BLK02440
C                                                                       BLK02450
      RETURN                                                            BLK02460
      END                                                               BLK02470
      SUBROUTINE INPAR
C
C*******************************************************************
C
C     THIS SUBROUTINE READS THE RUN PARAMETERS
C
C     ERT, INC.
C     696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C     RTDM
C
C*******************************************************************
C
C****************************************************
C
C    COMMON BLOCK FOR MODEL PARAMETERS AND SWITCHES
C
C****************************************************
C
      DIMENSION AY(6,3),BY(6,3),CY(6,3),
     X          AZ(6,3),BZ(6,3),CZ(6,3)
      COMMON /PR001/ HSCALE
      COMMON /PR002/ VSCALE
      COMMON /PR003/ USCALE
      COMMON /PR004/ ZWIND1,ZWIND2,IDILUT,ZA
      COMMON /PR005/ EXPON(6)
      COMMON /PR006/ ICOEF
      COMMON /PR007/ AY, BY, CY, XY1,XY2
      COMMON /PR008/ AZ, BZ, CZ, XZ1,XZ2
      COMMON /PR009/ IPPP,PPVPTG
      COMMON /PR010/ IBUOY,ALPHA
      COMMON /PR011/ IDMX
      COMMON /PR012/ ITRANS
      COMMON /PR013/ TERCOR(6)
      COMMON /PR014/ RVPTG(2)
      COMMON /PR015/ ITIPD
      COMMON /PR016/ IY
      COMMON /PR017/ IZ
      COMMON /PR018/ IRVPTG
      COMMON /PR019/ IHVPTG
      COMMON /PR020/ ISHEAR,SHCOEF
      COMMON /PR021/ IEPS
      COMMON /PR022/ IREFL
      COMMON /PR023/ IHORIZ,SECTOR(6)
      COMMON /PR024/ IEMIS
      COMMON /PR025/ IVERB
C
      REAL FIELD(6)
      DATA I99/'99'/,IPR/'PR'/,INAM/'PR'/
      INUM1 = 0
      INUM2 = 0
C
   10 INAMX = INAM
      INUM1X = INUM1
      INUM2X = INUM2
      READ (5,6000,ERR=9500) INAM,INUM1,INUM2,FIELD
 6000 FORMAT (A2,I1,I2,3X,6E8.0)
```

```
      IF (INAM .EQ. I99) GO TO 9000
C
      IF (INAM.NE.IPR) GO TO 50
C
      I = INUM2 + INUM1*100
      IF(I.LT.1.OR.I.GT.25) GO TO 50
C
C
      GO TO (100,200,300,400,500,600,700,800,900,1000,
     X          1100,1200,1300,1400,1500,1600,1700,1800,1900,2000,
     X          2100,2200,2300,2400,2500),I
C
   50 WRITE(6,51) INAM,INUM1,INUM2,INAMX,INUM1X,INUM2X
   51 FORMAT(' ILLEGAL PARAMETER NAME "',A2,I1,I2,'"',/,
     X ' LAST PARAMETER NAME SUCCESSFULLY PROCESSED WAS: ',A2,I1,I2,/)
      WRITE (6,52)
   52 FORMAT(//,' *FATAL ERROR*',//,' EXECUTION TERMINATING DUE TO ',
     X 'ERROR IN READING PARAMETER NAME')
C
      STOP
C
C     /PR001/
C
  100 HSCALE = FIELD(1)
      GO TO 10
C
C     /PR002/
C
  200 VSCALE = FIELD(1)
      GO TO 10
C
C     /PR003/
C
  300 USCALE = FIELD(1)
      GO TO 10
C
C     /PR004/
C
  400 ZWIND1 = FIELD(1)
      ZWIND2 = FIELD(2)
      IDILUT = INT(FIELD(3))
      ZA = FIELD(4)
      GO TO 10
C
C     /PR005/
C
  500 DO 550 J = 1,6
  550 EXPON(J) = FIELD(J)
      GO TO 10
C
C     /PR006/
C
  600 ICOEF = INT(FIELD(1))
      IF(ICOEF.LT.1.OR.ICOEF.GT.3) GO TO 9500
      GO TO 10
C
C     /PR007/
```

```
C                                                                       INP01150
  700   XY1 = FIELD(1)                                                  INP01160
        XY2 = FIELD(2)                                                  INP01170
        DO 750 I=1,3                                                    INP01180
  750   READ (5,6100,ERR=9500) (AY(IS,I),IS=1,6)                        INP01190
 6100   FORMAT(8X,6E8.0)                                                INP01200
        DO 760 I=1,3                                                    INP01210
  760   READ (5,6100,ERR=9500) (BY(IS,I),IS=1,6)                        INP01220
        DO 770 I=1,3                                                    INP01230
  770   READ (5,6100,ERR=9500) (CY(IS,I),IS=1,6)                        INP01240
        GO TO 10                                                        INP01250
C                                                                       INP01260
C       /PR008/                                                         INP01270
C                                                                       INP01280
  800   XZ1 = FIELD(1)                                                  INP01290
        XZ2 = FIELD(2)                                                  INP01300
        DO 850 I=1,3                                                    INP01310
  850   READ (5,6100,ERR=9500) (AZ(IS,I),IS=1,6)                        INP01320
        DO 860 I=1,3                                                    INP01330
  860   READ (5,6100,ERR=9500) (BZ(IS,I),IS=1,6)                        INP01340
        DO 870 I=1,3                                                    INP01350
  870   READ (5,6100,ERR=9500) (CZ(IS,I),IS=1,6)                        INP01360
        GO TO 10                                                        INP01370
C                                                                       INP01380
C       /PR009/                                                         INP01390
C                                                                       INP01400
  900   IPPP = INT(FIELD(1))                                            INP01410
        IF(IPPP.NE.0.AND.IPPP.NE.1) GO TO 9500                          INP01420
        PPVPTG = FIELD(2)                                               INP01430
        GO TO 10                                                        INP01440
C                                                                       INP01450
C       /PR010/                                                         INP01460
C                                                                       INP01470
 1000   IBUOY = INT(FIELD(1))                                           INP01480
        IF(IBUOY.NE.0.AND.IBUOY.NE.1) GO TO 9500                        INP01490
        ALPHA = FIELD(2)                                                INP01500
        GO TO 10                                                        INP01510
C                                                                       INP01520
C       /PR011/                                                         INP01530
C                                                                       INP01540
 1100   IDMX = INT(FIELD(1))                                            INP01550
        IF(IDMX.NE.0.AND.IDMX.NE.1) GO TO 9500                          INP01560
        GO TO 10                                                        INP01570
C                                                                       INP01580
C       /PR012/                                                         INP01590
C                                                                       INP01600
 1200   ITRANS = INT(FIELD(1))                                          INP01610
        IF(ITRANS.NE.0.AND.ITRANS.NE.1) GO TO 9500                      INP01620
        GO TO 10                                                        INP01630
C                                                                       INP01640
C       /PR013/                                                         INP01650
C                                                                       INP01660
 1300   DO 1350 J = 1,6                                                 INP01670
 1350   TERCOR(J) = FIELD(J)                                            INP01680
        GO TO 10                                                        INP01690
C                                                                       INP01700
C       /PR014/                                                         INP01710
```

```
C                                                                       INP01720
 1400 RVPTG(1) = FIELD(1)                                               INP01730
      RVPTG(2) = FIELD(2)                                               INP01740
      GO TO 10                                                          INP01750
C                                                                       INP01760
C     /PR015/                                                           INP01770
C                                                                       INP01780
 1500 ITIPD = INT(FIELD(1))                                             INP01790
      IF(ITIPD.NE.0.AND.ITIPD.NE.1) GO TO 9500                          INP01800
      GO TO 10                                                          INP01810
C                                                                       INP01820
C     /PR016/                                                           INP01830
C                                                                       INP01840
 1600 IY = INT(FIELD(1))                                                INP01850
      IF(IY.NE.0.AND.IY.NE.1) GO TO 9500                                INP01860
      GO TO 10                                                          INP01870
C                                                                       INP01880
C     /PR017/                                                           INP01890
C                                                                       INP01900
 1700 IZ = INT(FIELD(1))                                                INP01910
      IF(IZ.NE.0.AND.IZ.NE.1) GO TO 9500                                INP01920
      GO TO 10                                                          INP01930
C                                                                       INP01940
C     /PR018/                                                           INP01950
C                                                                       INP01960
 1800 IRVPTG = INT(FIELD(1))                                            INP01970
      IF(IRVPTG.NE.0.AND.IRVPTG.NE.1) GO TO 9500                        INP01980
      GO TO 10                                                          INP01990
C                                                                       INP02000
C     /PR019/                                                           INP02010
C                                                                       INP02020
 1900 IHVPTG = INT(FIELD(1))                                            INP02030
      IF(IHVPTG.NE.0.AND.IHVPTG.NE.1) GO TO 9500                        INP02040
      GO TO 10                                                          INP02050
C                                                                       INP02060
C     /PR020/                                                           INP02070
C                                                                       INP02080
 2000 ISHEAR = INT(FIELD(1))                                            INP02090
      IF(ISHEAR.NE.0.AND.ISHEAR.NE.1) GO TO 9500                        INP02100
      SHCOEF = FIELD(2)                                                 INP02110
      GO TO 10                                                          INP02120
C                                                                       INP02130
C     /PR021/                                                           INP02140
C                                                                       INP02150
 2100 IEPS = INT(FIELD(1))                                              INP02160
      IF(IEPS.NE.0.AND.IEPS.NE.1) GO TO 9500                            INP02170
      GO TO 10                                                          INP02180
C                                                                       INP02190
C     /PR022/                                                           INP02200
C                                                                       INP02210
 2200 IREFL = INT(FIELD(1))                                             INP02220
      IF(IREFL.NE.0.AND.IREFL.NE.1) GO TO 9500                          INP02230
      GO TO 10                                                          INP02240
C                                                                       INP02250
C     /PR023/                                                           INP02260
C                                                                       INP02270
 2300 IHORIZ = INT(FIELD(1))                                            INP02280
```

```
      IF(IHORIZ.LT.1.OR.IHORIZ.GT.3) GO TO 9500                         INP02290
      READ(5,6100) SECTOR                                               INP02300
      GO TO 10                                                          INP02310
C                                                                       INP02320
C     /PR024/                                                           INP02330
C                                                                       INP02340
 2400 IEMIS = INT(FIELD(1))                                             INP02350
      IF(IEMIS.NE.0.AND.IEMIS.NE.1) GO TO 9500                          INP02360
      GO TO 10                                                          INP02370
C                                                                       INP02380
C     /PR025/                                                           INP02390
C                                                                       INP02400
 2500 IVERB = INT(FIELD(1))                                             INP02410
      IF(IVERB.NE.0.AND.IVERB.NE.1) GO TO 9500                          INP02420
      GO TO 10                                                          INP02430
C                                                                       INP02440
 9000 RETURN                                                            INP02450
C                                                                       INP02460
 9500 WRITE (6,9598) INUM2                                              INP02470
 9598 FORMAT (/,' INPUT UNREADABLE OR OUT OF BOUNDS FOR PARAMETER #',   INP02480
     X I2)                                                              INP02490
      WRITE (6,9599)                                                    INP02500
 9599 FORMAT(//,' *FATAL ERROR*',//,' EXECUTION TERMINATING DUE TO ',   INP02510
     X 'ERROR IN READING PARAMETER VALUE(S).')                          INP02520
C                                                                       INP02530
      STOP                                                              INP02540
      END                                                               INP02550
```

```
        SUBROUTINE WRPAR
C
C********************************************************************
C
C       THIS SUBROUTINE PRINTS THE RUN PARAMETERS
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C
C********************************************************************
C
C******************************************************
C
C      COMMON BLOCK FOR MODEL PARAMETERS AND SWITCHES
C
C******************************************************
C
        DIMENSION AY(6,3),BY(6,3),CY(6,3),
     X          AZ(6,3),BZ(6,3),CZ(6,3)
        COMMON /PR001/ HSCALE
        COMMON /PR002/ VSCALE
        COMMON /PR003/ USCALE
        COMMON /PR004/ ZWIND1,ZWIND2,IDILUT,ZA
        COMMON /PR005/ EXPON(6)
        COMMON /PR006/ ICOEF
        COMMON /PR007/ AY, BY, CY, XY1,XY2
        COMMON /PR008/ AZ, BZ, CZ, XZ1,XZ2
        COMMON /PR009/ IPPP,PPVPTG
        COMMON /PR010/ IBUOY,ALPHA
        COMMON /PR011/ IDMX
        COMMON /PR012/ ITRANS
        COMMON /PR013/ TERCOR(6)
        COMMON /PR014/ RVPTG(2)
        COMMON /PR015/ ITIPD
        COMMON /PR016/ IY
        COMMON /PR017/ IZ
        COMMON /PR018/ IRVPTG
        COMMON /PR019/ IHVPTG
        COMMON /PR020/ ISHEAR,SHCOEF
        COMMON /PR021/ IEPS
        COMMON /PR022/ IREFL
        COMMON /PR023/ IHORIZ, SECTOR(6)
        COMMON /PR024/ IEMIS
        COMMON /PR025/ IVERB
C
        DIMENSION XZ(4)
C
        XSTARS=1.E20
C
C
C       PRINT PARAMETERS
C
         WRITE(6,9000)
 9000    FORMAT(//,10X,'MODEL PARAMETERS:',/)
        WRITE (6,9001)HSCALE,VSCALE,USCALE,ZWIND1,ZWIND2,IDILUT,ZA,EXPON
 9001   FORMAT (/,10X,'PR001:  HORIZONTAL SCALE IS ',F8.3,' METERS PER',WRP00580
     X  ' USER UNIT',//,10X,'PR002:  VERTICAL SCALE IS ',F8.3,' METERS 'WRP00590
     X  'PER USER UNIT',//,10X,'PR003:  WIND SPEED SCALE IS ',F8.3,      WRP00600
     X  ' M/SEC PER USER UNIT',//,10X,'PR004:  ANEMOMETER #1 HEIGHT ',   WRP00610
     X  'ABOVE ZA (USED FOR PLUME RISE) IS ',F5.1,' M',/,18X,            WRP00620
     X  'IF AVAILABLE, ANEMOMETER #2 ',                                  WRP00630
     X  'HEIGHT ABOVE ZA (USED FOR PLUME DILUTION) IS ',F5.1,' M',/,     WRP00640
     X  18X,'DILUTION WIND SPEED OPTION IS ',I1,6X,'(IF 0, ONE ',        WRP00650
     X  'WIND SPEED--AT STACK HEIGHT--IS USED FOR PLUME RISE AND ',      WRP00660
     X  'DILUTION',/,18X,'IF 1, WIND SPEED AT LEVEL #1 ',                WRP00670
     X  'IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE ',           WRP00680
     X  'AND TO PLUME HEIGHT FOR DILUTION',/,18X,'IF 2, WIND SPEED AT ',WRP00690
     X  'LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME',        WRP00700
     X  ' RISE,',/,18X,'AND THE SPEED AT LEVEL #2 IS ',                  WRP00710
     X  'EXTRAPOLATED TO PLUME HEIGHT FOR DILUTION)',                    WRP00720
     X  /,18X,'ZA (HEIGHT IN METERS ABOVE STACK BASE ELEVATION WHERE ',  WRP00730
     X  'THE WIND SPEED PROFILE IS ASSUMED TO ORIGINATE) = ',F8.3,       WRP00740
     X  //,10X,'PR005:  DEFAULT WIND SPEED PROFILE EXPONENTS ',          WRP00750
     X  'AS A FUNCTION OF STABILITY CLASS (1-6, RESPECTIVELY)',          WRP00760
     X   ':',/,30X,6F8.4)                                                WRP00770
C                                                                        WRP00780
        IF(ICOEF.EQ.1) WRITE(6,9002)                                     WRP00790
 9002   FORMAT(/,10X,'PR006, PR007, PR008:  DISPERSION COEFFICIENTS ',   WRP00800
     X  'ARE OF THE FORM A * X**B  + C, SPECIFIED BY THE USER AS ',      WRP00810
     X  'LISTED BELOW:',/)                                               WRP00820
        IF(ICOEF.EQ.2) WRITE(6,9003)                                     WRP00830
 9003   FORMAT(/,10X,'PR006:  DISPERSION COEFFICIENTS ARE PASQUILL-',    WRP00840
     X  'GIFFORD (UNLESS REPLACED BY ON-SITE TURBULENCE DATA).')         WRP00850
C                                                                        WRP00860
        IF(ICOEF.EQ.3) WRITE(6,9004)                                     WRP00870
 9004   FORMAT(/,10X,'PR006:  DISPERSION COEFFICIENTS ARE BRIGGS ',      WRP00880
     X  'RURAL/ASME-1979 (UNLESS REPLACED BY ON-SITE TURBULENCE DATA).')WRP00890
C                                                                        WRP00900
        IF(ICOEF.GT.1) GO TO 9100                                        WRP00910
        XZ(1)=0.                                                         WRP00920
        XZ(2)=XY1                                                        WRP00930
        XZ(3)=XY2                                                        WRP00940
        XZ(4)=XSTARS                                                     WRP00950
C                                                                        WRP00960
        WRITE (6,9008)                                                   WRP00970
 9008   FORMAT (10X,'SIGMA-Y:')                                          WRP00980
C                                                                        WRP00990
        DO 9080 IRANGE=1,3                                               WRP01000
 9080   WRITE (6,9009) XZ(IRANGE),XZ(IRANGE+1),                          WRP01010
     X  (AY(I,IRANGE),I=1,6),(BY(I,IRANGE),I=1,6),(CY(I,IRANGE),I=1,6)   WRP01020
 9009   FORMAT(21X,'RANGE OF X FROM ',F6.0,' TO ',F6.0,' METERS:',5X,    WRP01030
     X  'STABILITY CLASS',/,45X,'1',9X,'2',9X,'3',9X,'4',9X,'5',9X,'6',  WRP01040
     X  /,21X,'COEFFICIENT A',3X,6F10.3,/,21X,'COEFFICIENT B',3X,        WRP01050
     X  6F10.3,/,21X,'COEFFICIENT C',3X,6F10.3,/)                        WRP01060
C                                                                        WRP01070
        XZ(2)=XZ1                                                        WRP01080
        XZ(3)=XZ2                                                        WRP01090
C                                                                        WRP01100
        WRITE (6,9010)                                                   WRP01110
 9010   FORMAT (10X,'SIGMA-Z:')                                          WRP01120
C                                                                        WRP01130
        DO 9011 IRANGE=1,3                                               WRP01140
 9011   WRITE (6,9009) XZ(IRANGE),XZ(IRANGE+1),                         WRP01150
     X  (AZ(I,IRANGE),I=1,6),(BZ(I,IRANGE),I=1,6),(CZ(I,IRANGE),I=1,6)  WRP01160
C                                                                       WRP01170
         CALL PAGE                                                      WRP01180
C                                                                       WRP01190
 9100   IF(IPPP.EQ.0) WRITE(6,9013)                                     WRP01200
 9013   FORMAT(/,10X,'PR009:  PARTIAL PLUME PENETRATION OF MIXING LIDS',WRP01210
     X  ' IS NOT BEING USED.')                                          WRP01220
        IF(IPPP.EQ.1) WRITE(6,9014) PPVPTG                              WRP01230
 9014   FORMAT(/,10X,'PR009:  PARTIAL PLUME PENETRATION OF MIXING LIDS',WRP01240
     X  ' IS USED; VPTG ABOVE LID IS ',F7.4,' DEG K/M')                 WRP01250
        IF(IBUOY.EQ.0) WRITE(6,9016)                                    WRP01260
 9016   FORMAT(/,10X,'PR010:  BUOYANCY-ENHANCED PLUME DISPERSION IS ',  WRP01270
     X  'NOT BEING USED.')                                              WRP01280
        IF(IBUOY.EQ.1) WRITE(6,9017) ALPHA                              WRP01290
 9017   FORMAT(/,10X,'PR010:  BUOYANCY-ENHANCED PLUME DISPERSION IS ',  WRP01300
     X  'USED; PARAMETER ALPHA IS ',F8.3)                               WRP01310
        IF(IDMX.EQ.0) WRITE(6,9018)                                     WRP01320
 9018   FORMAT(/,10X,'PR011:  ACTUAL OBSERVED MIXING HEIGHTS USED FOR ',WRP01330
     X  'STABLE CONDITIONS')                                            WRP01340
        IF(IDMX.EQ.1) WRITE(6,9019)                                     WRP01350
 9019   FORMAT(/,10X,'PR011:  UNLIMITED MIXING HEIGHT USED FOR STABLE ',WRP01360
     X  'CONDITIONS')                                                   WRP01370
        IF(ITRANS.EQ.0) WRITE(6,9021)                                   WRP01380
 9021   FORMAT(/,10X,'PR012:  FINAL PLUME RISE ONLY IS USED.')          WRP01390
        IF(ITRANS.EQ.1) WRITE(6,9022)                                   WRP01400
 9022   FORMAT(/,10X,'PR012:  TRANSITIONAL PLUME RISE IS USED.')        WRP01410
        WRITE(6,9024) TERCOR                                            WRP01420
 9024   FORMAT(/,10X,'PR013:  PLUME PATH COEFFICIENTS FOR STABILITY ',  WRP01430
     X  'CLASSES 1-6: ',6F6.3)                                          WRP01440
        WRITE(6,9026) RVPTG                                             WRP01450
 9026   FORMAT(/,10X,'PR014:  DEFAULT VERTICAL POTENTIAL TEMPERATURE ', WRP01460
     X  'GRADIENTS USED FOR STABLE PLUME RISE (CLASSES 5 & 6): ',2F7.4) WRP01470
        IF(ITIPD.EQ.0) WRITE(6,9028)                                    WRP01480
 9028   FORMAT(/,10X,'PR015:  STACK-TIP DOWNWASH IS NOT USED.')         WRP01490
        IF(ITIPD.EQ.1) WRITE(6,9029)                                    WRP01500
 9029   FORMAT(/,10X,'PR015:  STACK-TIP DOWNWASH IS USED.')             WRP01510
        IF(IY.EQ.0) WRITE(6,9031)                                       WRP01520
 9031   FORMAT(/,10X,'PR016:  Y-COMPONENT TURBULENCE INTENSITY VALUES ',WRP01530
     X  'ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Y.') WRP01540
        IF(IY.EQ.1) WRITE(6,9032)                                       WRP01550
 9032   FORMAT(/,10X,'PR016:  Y-COMPONENT TURBULENCE INTENSITY VALUES ',WRP01560
     X  'ARE PROVIDED AND ARE USED TO OBTAIN SIGMA-Y.')                 WRP01570
        IF(IZ.EQ.0) WRITE(6,9034)                                       WRP01580
 9034   FORMAT(/,10X,'PR017:  Z-COMPONENT TURBULENCE INTENSITY VALUES ',WRP01590
     X  'ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Z.') WRP01600
        IF(IZ.EQ.1) WRITE(6,9035)                                       WRP01610
 9035   FORMAT(/,10X,'PR017:  Z-COMPONENT TURBULENCE INTENSITY VALUES ',WRP01620
     X  'ARE PROVIDED AND ARE USED TO OBTAIN SIGMA-Z.')                 WRP01630
        IF(IRVPTG.EQ.0) WRITE(6,9037)                                   WRP01640
 9037   FORMAT(/,10X,'PR018:  HOURLY VERTICAL POTENTIAL TEMPERATURE ',  WRP01650
     X  'GRADIENTS ARE NOT PROVIDED TO DETERMINE STABLE PLUME RISE;',/, WRP01660
     X  30X,'USE DEFAULT VALUES (SEE PR014).')                          WRP01670
        IF(IRVPTG.EQ.1) WRITE(6,9038)                                   WRP01680
 9038   FORMAT(/,10X,'PR018:  HOURLY VERTICAL POTENTIAL TEMPERATURE ',  WRP01690
     X  'GRADIENTS ARE PROVIDED FOR COMPUTING STABLE PLUME RISE.')      WRP01700
        IF(IHVPTG.EQ.0) WRITE(6,9039)                                   WRP01710
 9039   FORMAT(/,10X,'PR019:  HOURLY VERTICAL POTENTIAL TEMPERATURE ',   WRP01720
     X  'GRADIENTS ARE NOT PROVIDED TO DETERMINE HCRIT;',/,              WRP01730
     X  30X,'USE DEFAULT VALUES (SEE PR014).')                           WRP01740
        IF(IHVPTG.EQ.1) WRITE(6,9040)                                    WRP01750
 9040   FORMAT(/,10X,'PR019:  HOURLY VERTICAL POTENTIAL TEMPERATURE ',   WRP01760
     X  'GRADIENTS ARE PROVIDED FOR COMPUTING HCRIT.')                   WRP01770
        IF(ISHEAR.EQ.0) WRITE(6,9042)                                    WRP01780
 9042   FORMAT(/,10X,'PR020:  WIND DIRECTION SHEAR IS NOT USED IN ',     WRP01790
     X  'COMPUTATION OF SIGMA-Y.')                                       WRP01800
        IF(ISHEAR.EQ.1) WRITE(6,9043) SHCOEF                             WRP01810
 9043   FORMAT(/,10X,'PR020:  WIND DIRECTION SHEAR IS USED IN ',         WRP01820
     X  'COMPUTATION OF SIGMA-Y; COEFFICIENT = ',F5.2)                   WRP01830
        IF(IEPS.EQ.0) WRITE(6,9045)                                      WRP01840
 9045   FORMAT(/,10X,'PR021:  HOURLY VALUES OF WIND SPEED PROFILE ',     WRP01850
     X  'EXPONENT ARE NOT PROVIDED; USE DEFAULTS (SEE PR005).')          WRP01860
        IF(IEPS.EQ.1) WRITE(6,9046)                                      WRP01870
 9046   FORMAT(/,10X,'PR021:  HOURLY VALUES OF WIND SPEED PROFILE ',     WRP01880
     X  'EXPONENT ARE PROVIDED.')                                        WRP01890
        IF(IREFL.EQ.0) WRITE(6,9048)                                     WRP01900
 9048   FORMAT(/,10X,'PR022:  PARTIAL REFLECTION ALGORITHM IS NOT ',     WRP01910
     X  'BEING USED; FULL REFLECTION EMPLOYED.')                         WRP01920
        IF(IREFL.EQ.1) WRITE(6,9049)                                     WRP01930
 9049   FORMAT(/,10X,'PR022:  PARTIAL REFLECTION ALGORITHM IS BEING ',   WRP01940
     X  'USED; KEYWORD TERRAIN MUST BE USED TO READ IN TERRAIN.')        WRP01950
        IF(IHORIZ.EQ.1) WRITE(6,9055)                                    WRP01960
 9055   FORMAT(/,10X,'PR023:  OFF-CENTERLINE CONCENTRATIONS ARE ',       WRP01970
     X  'COMPUTED FOR ALL STABILITIES; NO SECTOR AVERAGING IS USED.')    WRP01980
        IF(IHORIZ.EQ.2) WRITE(6,9056) SECTOR                             WRP01990
 9056   FORMAT(/,10X,'PR023:  SECTOR AVERAGING IS USED FOR ALL ',        WRP02000
     X  'STABILITIES',/,15X,'   SECTOR WIDTHS (DEG) FOR STABILITIES ',   WRP02010
     X  '1-6 ARE ',6(F6.2,3X))                                           WRP02020
        IF(IHORIZ.EQ.3) WRITE(6,9057) SECTOR(5),SECTOR(6)                WRP02030
 9057   FORMAT(/,10X,'PR023:  SECTOR AVERAGING IS USED ONLY FOR ',       WRP02040
     X  'STABLE CONDITIONS; SECTOR WIDTHS (DEG) FOR STAB. 5 ',           WRP02050
     X  'AND 6 ARE ',F6.2,3X,F6.2)                                       WRP02060
        IF(IEMIS.EQ.0) WRITE(6,9059)                                     WRP02070
 9059   FORMAT(/,10X,'PR024:  HOURLY EMISSIONS DATA ARE NOT AVAILABLE;',WRP02080
     X  ' CONSTANT VALUES SPECIFIED IN THE STACKS SECTION ARE USED.')    WRP02090
        IF(IEMIS.EQ.1) WRITE(6,9060)                                     WRP02100
 9060   FORMAT(/,10X,'PR024:  HOURLY EMISSIONS DATA ARE AVAILABLE AND ',WRP02110
     X  'WILL REPLACE THE CONSTANT VALUES SPECIFIED IN THE STACKS ',     WRP02120
     X  'SECTION.')                                                      WRP02130
        IF(IVERB.EQ.0) WRITE(6,9062)                                     WRP02140
 9062   FORMAT(/,10X,'PR025:  DETAILED INFORMATION ABOUT EACH CASE ',    WRP02150
     X  'WILL NOT BE PRINTED.')                                          WRP02160
        IF(IVERB.EQ.1) WRITE(6,9063)                                     WRP02170
 9063   FORMAT(/,10X,'PR025:  DETAILED INFORMATION ABOUT EACH CASE ',    WRP02180
     X  'WILL BE PRINTED.')                                              WRP02190
C                                                                        WRP02200
        CALL PAGE                                                        WRP02210
C                                                                        WRP02220
        RETURN                                                           WRP02230
        END                                                              WRP02240
        SUBROUTINE STAKS
C
C*******************************************************************
C
C       THIS SUBROUTINE READS THE STACK PARAMETERS
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C
C********************************************************************
C
C******************************************************
C
C      COMMON BLOCK FOR STACK SPECIFIC DATA
C
C******************************************************
       COMMON /STACKS/
     X                SNAME(35),   @STACK NAMES
     X                HEIGHT(35),  @STACK HEIGHT (M)
     X                DIAMTR(35),  @STACK DIAMETER (M)
     X                EXITVL(35),  @STACK EXIT VELOCITY (M/SEC)
     X                STEMP(35),   @STACK GAS EXIT TEMP (DEG K)
     X                EMISR(35),   @EMISSION RATE  (G/SEC)
     X                UTMX,        @X-COORDINATE FOR ALL STACKS
     X                UTMY,        @Y-COORDINATE FOR ALL STACKS
     X                BASEHT,      @BASE HEIGHT FOR ALL STACKS
     X                NS,          @NUMBER OF STACKS
     X                EMSLBL       @LABEL FOR POLLUTANT
C
        COMMON /PR001/ HSCALE
        COMMON /PR002/ VSCALE
C
        DATA TEST/'9999'/
C
        NS = 1
C
        READ(5,1,END=5000,ERR=9900) UUTMX,UUTMY,UBASE,EMSLBL
    1   FORMAT(3F10.3,A4)
  100   CONTINUE
        READ(5,2,END=5000,ERR=9900) SNAME(NS),HEIGHT(NS),DIAMTR(NS),
     X  EXITVL(NS),STEMP(NS),EMISR(NS)
    2   FORMAT(A4,6X,5F10.3)
        IF(SNAME(NS) .EQ. TEST) GO TO 5000
        NS = NS + 1
        IF (NS.LE.36) GO TO 100
        WRITE(6,10)
   10   FORMAT(//,'   THE NUMBER OF STACKS EXCEEDS THE MAXIMUM OF 35.')
        WRITE(6,11)
   11   FORMAT(//,' *FATAL ERROR*',//,' EXECUTION TERMINATING DUE TO ',
     X  'ERROR IN NUMBER OF STACKS SPECIFIED.')
        STOP
C
 5000   NS = NS - 1
        UTMX = UUTMX * HSCALE      @ CONVERT TO METERS
        UTMY = UUTMY * HSCALE      @ CONVERT TO METERS
       BASEHT = UBASE * VSCALE  @ CONVERT TO METERS
       WRITE(6,15)
   15  FORMAT(//,10X,'MODELED STACK PARAMETERS:',///)
       WRITE(6,20) UUTMX,UUTMY,UTMX,UTMY,UBASE,BASEHT,EMSLBL
   20  FORMAT(10X,'X,Y COORDINATE OF ALL SOURCES (USER UNITS) IS (',
     X F10.2,' , ',F10.2,' )  OR  (',F10.2,' , ',F10.2,') METERS',/,
     X 10X,'BASE HEIGHT OF ALL SOURCES ',
     X '(USER UNITS) IS ',F10.3,' OR ',F10.3,' METERS',/,10X,
     X 'POLLUTANT IS ',A4)
C
C
       WRITE(6,30)
   30  FORMAT(///,10X,'CODE NAME   STACK HT (M)   DIAMETER (M)    ',
     X 'EXIT VEL (M/SEC)  STACK TEMP (K)  EMISSION RATE (G/SEC)',/)
C
       DO 6000 I = 1,NS
 6000  WRITE(6,40) I,SNAME(I),HEIGHT(I),DIAMTR(I),EXITVL(I),STEMP(I),
     X EMISR(I)
   40  FORMAT(8X,I2,3X,A4,5X,F9.3,7X,F7.3,11X,F7.3,10X,F8.3,10X,F10.3)
C
       RETURN
C
 9900 WRITE(6,50)
   50 FORMAT(//,' *** READ ERROR IN STACKS ***')
      WRITE(6,60)
   60 FORMAT(//,' *FATAL ERROR*',//,' EXECUTION TERMINATING DUE TO ',
     X'FORMAT ERROR IN STACKS SECTION.')
C
      STOP
      END
      SUBROUTINE POINTS
C
C***********************************************************************
C
C       THIS SUBROUTINE READS THE RECEPTOR LOCATIONS AND HEIGHTS.
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C
C********************************************************************
C
C******************************************************
C
C      COMMON BLOCK FOR STACK SPECIFIC DATA
C
C******************************************************
      COMMON /STACKS/
     X                SNAME(35),   @STACK NAMES
     X                HEIGHT(35),  @STACK HEIGHT (M)
     X                DIAMTR(35),  @STACK DIAMETER (M)
     X                EXITVL(35),  @STACK EXIT VELOCITY (M/SEC)
     X                STEMP(35),   @STACK GAS EXIT TEMP (DEG K)
     X                EMISR(35),   @EMISSION RATE  (G/SEC)
     X                UTMX,        @X-COORDINATE FOR ALL STACKS
     X                UTMY,        @Y-COORDINATE FOR ALL STACKS
     X                BASEHT,      @BASE HEIGHT FOR ALL STACKS
     X                NS,          @NUMBER OF STACKS
     X                EMSLBL       @LABEL FOR POLLUTANT
C
C******************************************************
C
C      COMMON BLOCK FOR RECEPTOR SPECIFIC DATA
C
C******************************************************
C
      COMMON /PLACE/ RX(400),RY(400),RZ(400),NR
C             RX               @RECEPTOR X-COORDINATES, METERS
C             RY               @RECEPTOR Y-COORDINATES,  METERS
C             RZ               @RECEPTOR TERRAIN HEIGHTS, USER UNITS
C
      COMMON /PR001/ HSCALE
      COMMON /PR002/ VSCALE
C
      REAL NAME(8)
      DATA TEST/'9999'/
C
      NR = 0
      I1 = 0
      I2 = 0
      CALL PAGE
C
   10 WRITE (6,601)
  601 FORMAT (//,10X,'RECEPTOR POINT INFORMATION (ALL COORDINATES IN',
     X ' USER UNITS):',///,
     X 10X,'RECEPTOR',4X,'X-COORD',4X,'Y-COORD',4X,'HEIGHT',
     X 5X,'NAME',/)
C
      NL = 10
      CALL LINES(NL,IZ)
C
   30 READ (5,502,END=900,ERR=9000) DELIM, X, Y, Z, NAME
  502 FORMAT (A4,6X,3F10.0,8A4)
C
      IF(DELIM .EQ. TEST) GO TO 900
C
      NR = NR+1
      IFLAG = '    '
      IF (NR .GT. 400) GO TO 550
      GO TO 600
  550 WRITE(6,7000)
 7000 FORMAT(//,'   THE NUMBER OF POINTS EXCEEDS THE MAXIMUM OF 400.')
      WRITE(6,8000)
 8000 FORMAT(//,' *FATAL ERROR*',//,' EXECUTION TERMINATING DUE TO ',
     X 'A USER SPECIFICATION OF MORE TOO MANY RECEPTOR POINTS.')
      STOP
C
  600 RX(NR) = X * HSCALE
      RY(NR) = Y * HSCALE
      RZ(NR) = Z * VSCALE
      DO 610 I = 1,NS
      IF(RZ(NR).LE.HEIGHT(I)+BASEHT) GO TO 605
      IFLAG = '**  '
      I2 = 1
      GO TO 650
  605 IF(RZ(NR).GE.BASEHT) GO TO 610
      IFLAG = '*   '
      I1 = 1
  610 CONTINUE
C
  650 WRITE (6,660) NR, X, Y, Z, IFLAG,NAME
  660 FORMAT (10X,I3,7X,2(F8.2,3X),F8.2,A2,1X,8A4)
      NL = 1
      CALL LINES(NL,IZ)
      IF(IZ.EQ.1) GO TO 10
      GO TO 30
C
  900 IF(I1.EQ.1) WRITE(6,700)
  700 FORMAT(/,'  *  THIS RECEPTOR IS LOWER IN ELEVATION THAN THE ',
     X '(COMMON) STACK BASE.',/,'      CAUTION SHOULD BE USED ',
     X 'IN INTERPRETATION OF CONCENTRATIONS FOR THIS RECEPTOR.')
      IF(I2.EQ.1) WRITE(6,750)
  750 FORMAT(/,'  ** THIS RECEPTOR IS HIGHER IN ELEVATION THAN THAT ',
     X 'OF THE LOWEST STACK TOP.',/,'      SPECIAL ALGORITHMS ',
     X 'CONCERNING PLUME IMPINGEMENT AND REFLECTION MAY INFLENCE ',
     X 'CONCENTRATIONS MODELED AT THIS RECEPTOR.')
      RETURN
C
 9000 WRITE(6,9100)
 9100 FORMAT(//,' **** READ ERROR IN POINTS ****')
      WRITE(6,9200)
 9200 FORMAT(' * FATAL ERROR *',//,' EXECUTION TERMINATED DUE TO ',
     X 'A FORMAT ERROR IN THE POINTS SECTION.')
```

```
C                                                               PNT01150
      STOP                                                      PNT01160
      END                                                       PNT01170
      SUBROUTINE TERAIN
C
C*******************************************************************
C
C       THIS SUBROUTINE READS THE TERRAIN INFORMATION
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C
C*******************************************************************
C
C****************************************************
C
C      COMMON BLOCK FOR TERRAIN DESCRIPTION DATA
C
C****************************************************
      COMMON /TERR/
     X                BEGHT,       @BEGINNING CONTOUR HT, USER UNITS
     X                HTINCR,      @CONTOUR INCREMENT, USER UNITS
     X                CONTUR(36,21)@DISTANCES FROM SOURCE ALONG EACH
     X                             @10-DEG RADIAL FOR HEIGHTS STARTING
     X                             @AT BEGHT, IN INCREMENTS OF HTINCR--
     X                             @UP TO 20 DISTANCES (CONTOUR INCRE-
     X                             @MENTS) ALLOWED ALONG EACH RADIAL
C
C****************************************************
C
C      COMMON BLOCK FOR RECEPTOR SPECIFIC DATA
C
C****************************************************
C
      COMMON /PLACE/ RX(400),RY(400),RZ(400),NR
C           RX                @RECEPTOR X-COORDINATES, METERS
C           RY                @RECEPTOR Y-COORDINATES,  METERS
C           RZ                @RECEPTOR TERRAIN HEIGHTS, USER UNITS
C
C*****************************************[illegible]*******[illegible]***
C
C      COMMON BLOCK FOR STACK SPECIFIC D[illegible]
C
C****************************************************
      COMMON /STACKS/
     X                SNAME(35),   @STACK NAMES
     X                HEIGHT(35),  @STACK HEIGHT (M)
     X                DIAMTR(35),  @STACK DIAMETER (M)
     X                EXITVL(35),  @STACK EXIT VELOCITY (M/SEC)
     X                STEMP(35),   @STACK GAS EXIT TEMP (DEG K)
     X                EMISR(35),   @EMISSION RATE  (G/SEC)
     X                UTMX,        @X-COORDINATE FOR ALL STACKS
     X                UTMY,        @Y-COOP[illegible]ATE FOR ALL STACKS
     X                BASEHT,      @BASE [illegible]T FOR ALL STACKS
     X                NS,          @NUMBF[illegible] STACKS
     X                EMSLBL       @LABE[illegible] POLLUTANT
C
      COMMON /PR001/ HSCALE
      COMMON /HEAD/ NPAGE,NLINE
C
      REAL MAP(55,55),CODES(20),CONTHT(20)
      DATA CONTUR/756*0./, BEGHT/0./, HTINCR/0./
      DATA CODES/'A','B','C','D','E','F','G','H','I','J','K','L','M',
     X 'N','O','P','Q','R','S','T'/
      DATA BLANK/' '/,PLUS/'+'/,STAR/'*'/
C
      CALL PAGE
C
      READ(5,1,ERR=9000) BEGHT, HTINCR
    1 FORMAT(2F10.3)
      IF(BEGHT.GT.0.0.AND.HTINCR.GT.0.0) GO TO 500
      WRITE(6,2) BEGHT,HTINCR
    2 FORMAT(/,'  BEGINNING HEIGHT (',F10.3,') AND/OR CONTOUR ',
     X 'INCREMENT (',F10.3,') IS OUT OF BOUNDS.')
  400 WRITE(6,3)
    3 FORMAT(//,' *FATAL ERROR*',//,' EXECUTION TERMINATING DUE TO ',
     X'UNUSABLE SPECIFICATION IN TERRAIN SECTION.')
      STOP
C
  500 CONTHT(1) = BEGHT
      DO 550 I = 2,20
  550 CONTHT(I) = BEGHT + HTINCR * (I-1)
C
      XMAX = 0.0
      XMIN = 0.0
      YMAX = 0.0
      YMIN = 0.0
C
      DO 1000 I = 1,36
      NUM = 0
      READ(5,4,ERR=9000,END=2000) IWD,(CONTUR(I,J),J=1,20)
    4 FORMAT(I3,7X,10F7.2,/,10X,10F7.2)
      IF(IWD.EQ.I*10) GO TO 600
      IDIR = I*10
      WRITE(6,6) IWD,IDIR
    6 FORMAT(/,'  WIND DIRECTION SPECIFIED FOR TERRAIN (',I3,') DOES',
     X ' NOT AGREE WITH EXPECTED DIRECTION (',I3,   ')
      GO TO 400
  600 DO 700 J = 1,20
      IF(CONTUR(I,J).LT.0.0) GO TO 800    @  END OF TERRAIN DATA
      IF(IWD.EQ.999) GO TO 2000
      IF(J.EQ.1) GO TO 700
      IF(CONTUR(I,J).GT.CONTUR(I,J-1)) GO TO 700
      WRITE(6,7) IWD,J
    7 FORMAT(/,'  FOR WIND DIRECTION OF ',I3,' DEGREES, THE DISTANCE',
     X ' TO CONTOUR # ',I2,' DOES NOT INCREASE OVER THE PREVIOUS ',
     X 'DISTANCE.')
      GO TO 400
  700 NUM = NUM + 1
C
  800 CONTUR(I,21) = FLOAT(NUM)
      IF(NUM.EQ.0) GO TO 1000
      THETA = FLOAT(I*10)
      R = CONTUR(I,NUM) * HSCALE
      X = R * COS((270. - THETA)/57.2958)
      Y = R * SIN((270. - THETA)/57.2958)                               TER01150
      IF(XMAX.LT.X) XMAX = X                                            TER01160
      IF(XMIN.GT.X) XMIN = X                                            TER01170
      IF(YMAX.LT.Y) YMAX = Y                                            TER01180
      IF(YMIN.GT.Y) YMIN = Y                                            TER01190
 1000 CONTINUE                                                          TER01200
      GO TO 2500                                                        TER01210
C                                                                       TER01220
 2000 WRITE(6,8)                                                        TER01230
    8 FORMAT(/,'  NUMBER OF DIRECTIONS FOR WHICH TERRAIN IS ',          TER01240
     X'SPECIFIED IS NOT 36, AS EXPECTED.')                              TER01250
      GO TO 400                                                         TER01260
C                                                                       TER01270
C     PRINT CONTOUR INFORMATION                                         TER01280
C                                                                       TER01290
 2500 WRITE(6,10) CONTHT                                                TER01300
   10 FORMAT(//,10X,'TERRAIN INFORMATION:',///,18X,'TABLE OF ',         TER01310
     X'DISTANCES (KM) FROM THE SOURCE TO ELEVATION CONTOURS AS A ',     TER01320
     X'FUNCTION OF WIND DIRECTION',///,60X,'ELEVATION IN USER UNITS:',TER01330
     X//,' WIND DIR.  ',20F6.0,/)                                       TER01340
      DO 2600 I = 1,36                                                  TER01350
      IDIR = I*10                                                       TER01360
      NUM = IFIX(CONTUR(I,21))                                          TER01370
      WRITE(6,12) IDIR,(CONTUR(I,J),J=1,NUM)                            TER01380
   12 FORMAT(3X,I3,6X,20F6.2)                                           TER01390
 2600 CONTINUE                                                          TER01400
C                                                                       TER01410
C     START TO FILL CONTOUR MAP                                         TER01420
C                                                                       TER01430
 3000 DO 3100 I = 1,55                                                  TER01440
      DO 3100 J = 1,55                                                  TER01450
 3100 MAP(I,J) = BLANK                                                  TER01460
      XRANGE = AMAX1(XMAX - XMIN,0.1)                                   TER01470
      YRANGE = AMAX1(YMAX - YMIN,0.1)                                   TER01480
      IX = INT(-XMIN/XRANGE * 54. + 1.5)                                TER01490
      IY = 56 - INT(-YMIN/YRANGE * 54. + 1.5)                           TER01500
      MAP(IY,IX) = PLUS    @ POSITION FOR SOURCE                        TER01510
C                                                                       TER01520
C     ADD TERRAIN POINTS SPECIFIED ABOVE                                TER01530
C                                                                       TER01540
      DO 4000 I = 1,36                                                  TER01550
      NMAX = INT(CONTUR(I,21))                                          TER01560
      IF(NMAX.EQ.0) GO TO 4000                                          TER01570
      DO 3500 J = 1,NMAX                                                TER01580
      R = CONTUR(I,J) * HSCALE                                          TER01590
      THETA = FLOAT(I*10)                                               TER01600
      X = R * COS((270. - THETA)/57.2958)                               TER01610
      Y = R * SIN((270. - THETA)/57.2958)                               TER01620
      IX = INT((X-XMIN)/XRANGE * 54. + 1.5)                             TER01630
      IY = 56 - INT((Y-YMIN)/YRANGE * 54. + 1.5)                        TER01640
      MAP(IY,IX) = CODES(J)    @ POSITION FOR CONTOUR                   TER01650
 3500 CONTINUE                                                          TER01660
 4000 CONTINUE                                                          TER01670
C                                                                       TER01680
C     ADD RECEPTOR POINTS IF THEY ARE WITHIN THE MAPPED AREA            TER01690
C                                                                       TER01700
      DO 5000 I = 1,NR                                                  TER01710
      X = RX(I) - UTMX
      Y = RY(I) - UTMY
      IX = INT((X-XMIN)/XRANGE * 54. + 1.5)
      IY = 56 - INT((Y-YMIN)/YRANGE * 54. + 1.5)
      IF(IX.LT.1.OR.IX.GT.55.OR.IY.LT.1.OR.IY.GT.55) GO TO 5000
      MAP(IY,IX) = STAR
 5000 CONTINUE
C
C     PRINT THE MAP
C
      NPAGE = NPAGE + 1
      WRITE(6,20) XMIN,XMAX,YMIN,YMAX
   20 FORMAT('1',' MAP OF USER-SPECIFIED TERRAIN:  LETTERS (SOME ',
     X 'OVERWRITTEN) DENOTE ELEVATIONS (SEE TABLE); "+" = SOURCE;',
     X ' "*" = A RECEPTOR POINT',/,6X,'DISTANCES FROM SOURCE ',
     X '(0,0):  XMIN = ',F9.2,
     X ' M,     XMAX = ',F9.2,' M,     YMIN = ',F9.2,' M,     ',
     X 'YMAX = ',F9.2,' M')
      WRITE(6,21) ((MAP(I,J),J=1,55),I=1,10)
   21 FORMAT(9(6X,55(A1,1X),/),6X,55(A1,1X))
      WRITE(6,22) ((MAP(I,J),J=1,55),I=11,13)
   22 FORMAT(6X,55(A1,1X),'   CONTOUR',/,6X,55(A1,1X),'   CODES  ',
     X 6X,55(A1,1X))
      WRITE(6,23) ((MAP(I+13,J),J=1,55),CODES(I),CONTHT(I),I=1,20)
   23 FORMAT(19(6X,55(A1,1X),2X,A1,1X,F8.2,/),6X,55(A1,1X),2X,A1,
     X 1X,F8.2)
      WRITE(6,24) ((MAP(I,J),J=1,55),I=34,55)
   24 FORMAT(22(6X,55(A1,1X),/),6X,55(A1,1X))
C
      RETURN
C
 9000 WRITE(6,30)
   30 FORMAT(//,' *** READ ERROR IN TERRAIN ***')
      WRITE(6,40)
   40 FORMAT(//,' *FATAL ERROR*',//,' EXECUTION TERMINATING DUE TO ',
     X 'FORMAT ERROR IN TERRAIN SECTION.')
C
      STOP
      END
      SUBROUTINE RTXEQ
C*******************************************************
C
C     THE SUBROUTINE READS THE HOURLY DATA AND PASSES
C     IT TO THE COMPUTATIONAL ROUTINES.
C
C     ERT, INC.
C     696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C     RTDM
C*******************************************************
C
C*******************************************************
C
C     COMMON BLOCK FOR STACK SPECIFIC DATA
C
C*******************************************************
      COMMON /STACKS/
     X                SNAME(35),     @STACK NAMES
     X                HEIGHT(35),    @STACK HEIGHT (M)
     X                DIAMTR(35),    @STACK DIAMETER (M)
     X                EXITVL(35),    @STACK EXIT VELOCITY (M/SEC)
     X                STEMP(35),     @STACK GAS EXIT TEMP (DEG K)
     X                EMISR(35),     @EMISSION RATE  (G/SEC)
     X                UTMX,          @X-COORDINATE FOR ALL STACKS
     X                UTMY,          @Y-COORDINATE FOR ALL STACKS
     X                BASEHT,        @BASE HEIGHT FOR ALL STACKS
     X                NS,            @NUMBER OF STACKS
     X                EMSLBL         @LABEL FOR POLLUTANT
C
C*******************************************************
C
C     COMMON BLOCK FOR HOURLY METEOROLOGICAL DATA
C
C*******************************************************
      COMMON /MET/
     X                WDIR,          @ WIND DIRECTION
     X                WSPD,          @ WIND SPEED #1 (M/SEC)
     X                DMX,           @ MIXING HEIGHT (M)
     X                IST,           @ STABILITY CLASS
     X                TEMP,          @ AMBIENT TEMPERATURE (DEG K)
     X                XIY,           @ TURBULENCE, Y-COMPONENT
     X                XIZ,           @ TURBULENCE, Z-COMPONENT
     X                PRVPTG,        @ PLUME RISE VPTG
     X                HCVPTG,        @ HCRIT VPTG
     X                DTHETA,        @ HORIZONTAL WIND DIRECTION SHEAR
     X                EPS,           @ WIND SPEED PROFILE EXPONENT
     X                WSPD2          @ WIND SPEED #2 (M/SEC)
C
C*******************************************************
C
C     COMMON BLOCK FOR MODEL PARAMETERS AND SWITCHES
C
C*******************************************************
C
      DIMENSION AY(6,3),BY(6,3),CY(6,3),
     X          AZ(6,3),BZ(6,3),CZ(6,3)
```

```
       COMMON /PR001/ HSCALE                                            RTX00580
       COMMON /PR002/ VSCALE                                            RTX00590
       COMMON /PR003/ USCALE                                            RTX00600
       COMMON /PR004/ ZWIND1,ZWIND2,IDILUT,ZA                           RTX00610
       COMMON /PR005/ EXPON(6)                                          RTX00620
       COMMON /PR006/ ICOEF                                             RTX00630
       COMMON /PR007/ AY, BY, CY, XY1,XY2                               RTX00640
       COMMON /PR008/ AZ, BZ, CZ, XZ1,XZ2                               RTX00650
       COMMON /PR009/ IPPP,PPVPTG                                       RTX00660
       COMMON /PR010/ IBUOY,ALPHA                                       RTX00670
       COMMON /PR011/ IDMX                                              RTX00680
       COMMON /PR012/ ITRANS                                            RTX00690
       COMMON /PR013/ TERCOR(6)                                         RTX00700
       COMMON /PR014/ RVPTG(2)                                          RTX00710
       COMMON /PR015/ ITIPD                                             RTX00720
       COMMON /PR016/ IY                                                RTX00730
       COMMON /PR017/ IZ                                                RTX00740
       COMMON /PR018/ IRVPTG                                            RTX00750
       COMMON /PR019/ IHVPTG                                            RTX00760
       COMMON /PR020/ ISHEAR,SHCOEF                                     RTX00770
       COMMON /PR021/ IEPS                                              RTX00780
       COMMON /PR022/ IREFL                                             RTX00790
       COMMON /PR023/ IHORIZ,SECTOR(6)                                  RTX00800
       COMMON /PR024/ IEMIS                                             RTX00810
C                                                                       RTX00820
       COMMON /PR025/ IVERB                                             RTX00830
C                                                                       RTX00840
       REAL OEMISR(35),OXVEL(35),OSTEMP(35)                             RTX00850
      INTEGER OIST                                                      RTX00860
C                                                                       RTX00870
       CALL PAGE                                                        RTX00880
C                                                                       RTX00890
C     READ INITIAL PERSISTENCE VALUES FOR METEOROLOGY                   RTX00900
C                                                                       RTX00910
      READ (5,1,ERR=9000) OWDIR,OWSPD,ODMX,OLDIST,OTEMP,OIY,OIZ,        RTX00920
     X OPRDT,OHCDT,ODTH,OEPS,OWSPD2                                     RTX00930
    1 FORMAT(8X,12F6.0)                                                 RTX00940
      OIST = INT(OLDIST)                                                RTX00950
      IF(OIST.EQ.7) OIST = 6                                            RTX00960
      OWSPD = OWSPD * USCALE                                            RTX00970
      OWSPD2 = OWSPD2 * USCALE                                          RTX00980
      OTEMP = (OTEMP-32.)/1.8 + 273.15                                  RTX00990
C                                                                       RTX01000
      DO 500 I = 1,NS                                                   RTX01010
      OEMISR(I) = EMISR(I)                                              RTX01020
      OXVEL(I) = EXITVL(I)                                              RTX01030
  500 OSTEMP(I) = STEMP(I)                                              RTX01040
C                                                                       RTX01050
      ICOUNT=0                                                          RTX01060
C                                                                       RTX01070
       WRITE(6,2)                                                       RTX01080
    2  FORMAT(/,' THE CODE FOR MISSING DATA IS PRESENTED AS FOLLOWS:', RTX01090
     X  /,'    A "1" IS INCLUDED IF WIND DIRECTION IS MISSING,',/,      RTX01100
     X  '    A "2" IS INCLUDED IF WIND SPEED IS MISSING,',/,            RTX01110
     X  '    A "3" IS INCLUDED IF MIXING HEIGHT IS MISSING,',/,         RTX01120
     X  '    A "4" IS INCLUDED IF STABILITY CLASS IS MISSING,',/,       RTX01130
     X  '    A "5" IS INCLUDED IF AMBIENT TEMPERATURE IS MISSING.',/,   RTX01140
     X  '   IF THERE IS MISSING DATA FOR ANY OF THESE PARAMETERS, THE ',RTX01150
     X  'PREVIOUS GOOD VALUE IS USED.',/,'   IF THERE IS MISSING DATA',  RTX01160
     X  ' FOR OPTIONAL PARAMETERS, THE DEFAULT VALUE (OBTAINED FROM ',   RTX01170
     X  'THE STABILITY CLASS) IS USED.',//)                              RTX01180
C                                                                        RTX01190
        IF1 = '*   '     @ SET PRINT FLAGS FOR OPTIONAL MET              RTX01200
        IF2 = '*   '                                                     RTX01210
        IF3 = '*   '                                                     RTX01220
        IF4 = '*   '                                                     RTX01230
        IF5 = '*   '                                                     RTX01240
        IF6 = '*   '                                                     RTX01250
        IF7 = '*   '                                                     RTX01260
        IPRINT = 1                                                       RTX01270
        K = 0                                                            RTX01280
        IF(IY.EQ.0) GO TO 600                                            RTX01290
        IF1 = '    '                                                     RTX01300
        K = K + 1                                                        RTX01310
  600   IF(IZ.EQ.0) GO TO 610                                            RTX01320
        IF2 = '    '                                                     RTX01330
        K = K + 1                                                        RTX01340
  610   IF(IRVPTG.EQ.0) GO TO 620                                        RTX01350
        IF3 = '    '                                                     RTX01360
        K = K + 1                                                        RTX01370
  620   IF(IHVPTG.EQ.0) GO TO 630                                        RTX01380
        IF4 = '    '                                                     RTX01390
        K = K + 1                                                        RTX01400
  630   IF(ISHEAR.EQ.0) GO TO 640                                        RTX01410
        IF5 = '    '                                                     RTX01420
        K = K + 1                                                        RTX01430
  640   IF(IEPS.EQ.0) GO TO 650                                          RTX01440
        IF6 = '    '                                                     RTX01450
        K = K + 1                                                        RTX01460
  650   IF(IDILUT.LT.2) GO TO 700                                        RTX01470
        IF7 = '    '                                                     RTX01480
        K = K + 1                                                        RTX01490
  700   IF(K.EQ.7) IPRINT = 0                                            RTX01500
C                                                                        RTX01510
C       LOOP OVER ALL DATA IN DATAFILE                                   RTX01520
C                                                                        RTX01530
 1000   ICOUNT = ICOUNT + 1                                              RTX01540
        NMISS = 0                                                        RTX01550
C                                                                        RTX01560
        READ(7,5,ERR=9000,END=5000) IYR,IDAY,IHR,WDIR,WSPD,DMX,STAB,     RTX01570
     X   TEMP,XIY,XIZ,PRVPTG,HCVPTG,DTHETA,EPS,WSPD2                     RTX01580
    5   FORMAT(I2,I3,I2,1X,12F6.0)                                       RTX01590
        WSPD = WSPD * USCALE                                             RTX01600
        WSPD2 = WSPD2 * USCALE                                           RTX01610
        IST = INT(STAB)                                                  RTX01620
        TEMP = (TEMP-32.)/1.8 + 273.15                                   RTX01630
        IF(IST.EQ.7) IST = 6                                             RTX01640
        IF(IEMIS.EQ.0) GO TO 1500                                        RTX01650
C                                                                        RTX01660
        DO 1200 I = 1,NS                                                 RTX01670
        READ(8,7,ERR=9500,END=5000) JYR,JDAY,JHR,EMISR(I),EXITVL(I),     RTX01680
     X  STEMP(I)                                                         RTX01690
    7   FORMAT(I2,I3,I2,3X,3F10.0)                                       RTX01700
        IF(JYR.NE.IYR.OR.JDAY.NE.IDAY.OR.JHR.NE.IHR) GO TO 8000          RTX01710
 1200   CONTINUE
C
 1500   IF(ICOUNT.EQ.1) GO TO 1700
        KHR = IHR
        KDAY = IDAY
        IF(KHR.GT.1) GO TO 1600
        KHR = 25
        KDAY = KDAY - 1
        IF(KDAY.LT.1) KDAY = 366
        IF(LASTYR/4*4.NE.LASTYR.AND.KDAY.EQ.366) KDAY = 365
 1600   IF(KHR - LASTHR.NE.1) GO TO 1650
        IF(KDAY.NE.LASTDA) GO TO 1650
        GO TO 1700
C
 1650   WRITE(6,10) IYR,IDAY,IHR
   10   FORMAT(10X,'WARNING:  HOURLY SEQUENCE OF INPUT DATA HAS BEEN ',
     X  'INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: ',I2,1X,I3,1X,I2)
C
C       CHECK FOR MISSING DATA
C
 1700   IF(WDIR.GE.0.0.AND.WDIR.LE.360.) GO TO 1710
        WDIR = OWDIR
        NMISS = NMISS + 10000
 1710   IF(WSPD.GT.0.0.AND.WSPD.LE.98.9) GO TO 1720
        WSPD = OWSPD
        NMISS = NMISS + 2000
 1720   IF(WSPD.LT.1.0) WSPD = 1.0  @ SET MINIMUM WIND SPEED TO 1 M/SEC
        IF(IST.GE.1.AND.IST.LE.6) GO TO 1730
        IST = OIST
        NMISS = NMISS + 40
 1730   IF(.NOT.(IST.GT.4.AND.IDMX.EQ.1)) GO TO 1735
        DMX = 9999.
        GO TO 1740
 1735   IF(DMX.GE.0.0) GO TO 1740
        DMX = ODMX
        NMISS = NMISS + 300
 1740   IF(TEMP.GT.200.0 .AND. TEMP.LT.330.) GO TO 1750
        TEMP = OTEMP
        NMISS = NMISS + 5
 1750   IF(XIY.LT.0.0.OR.XIY.GT.3.14) XIY = OIY
        IF(XIZ.LT.0.0.OR.XIZ.GT.3.14) XIZ = OIZ
        IF(PRVPTG.LT.0.0.OR.PRVPTG.GT.8.99) PRVPTG = OPRDT
        IF(HCVPTG.LT.0.0.OR.HCVPTG.GT.8.99) HCVPTG = OHCDT
        IF(DTHETA.LT.0.0.OR.DTHETA.GT.180.) DTHETA = ODTH
        IF(EPS.LT.-8.99.OR.EPS.GT.8.99) EPS = OEPS
        IF(WSPD2.LE.0.0.OR.WSPD2.GT.98.9) WSPD2 = OWSPD2
C
        IF(NMISS.GT.0) WRITE(6,12) IYR,IDAY,IHR,NMISS
   12   FORMAT('  MISSING DATA CODE FOR YEAR, DAY, HOUR ',I2,1X,I3,1X,
     X  I2,' IS ',I5)
C
        OWDIR = WDIR
        OWSPD = WSPD
        ODMX = DMX
        OIST = IST
        OTEMP = TEMP
        OIY = XIY
```

```
      OIZ = XIZ                                                         RTX02290
      OPRDT = PRVPTG                                                    RTX02300
      OHCDT = HCVPTG                                                    RTX02310
      ODTH = DTHETA                                                     RTX02320
      OEPS = EPS                                                        RTX02330
      OWSPD2 = WSPD2                                                    RTX02340
C                                                                       RTX02350
      IF(IEMIS.EQ.0) GO TO 3000                                         RTX02360
C                                                                       RTX02370
      DO 2500 I = 1,NS                                                  RTX02380
      IF(EMISR(I).LT.0.0) EMISR(I) = OEMISR(I)                          RTX02390
      IF(EXITVL(I).LT.0.0) EXITVL(I) = OXVEL(I)                         RTX02400
      IF(STEMP(I).LT.0.0) STEMP(I) = OSTEMP(I)                          RTX02410
      OEMISR(I) = EMISR(I)                                              RTX02420
      OXVEL(I) = EXITVL(I)                                              RTX02430
      OSTEMP(I) = STEMP(I)                                              RTX02440
 2500 CONTINUE                                                          RTX02450
C                                                                       RTX02460
 3000 LASTYR = IYR                                                      RTX02470
      LASTDA = IDAY                                                     RTX02480
      LASTHR = IHR                                                      RTX02490
      IF(IVERB.EQ.0) GO TO 3500                                         RTX02500
      WRITE(6,17)                                                       RTX02510
   17 FORMAT(//,1X,130('-'),/)                                          RTX02520
      WRITE(6,18) ICOUNT,IYR,IDAY,IHR,WDIR,WSPD,DMX,IST,TEMP,XIY,       RTX02530
     X IF1,XIZ,IF2,PRVPTG,IF3,HCVPTG,IF4,DTHETA,IF5,EPS,IF6,WSPD2,IF7  RTX02540
   18 FORMAT('  CASE-HOUR # ',I4,10X,'YEAR, DAY, HOUR: ',I2,1X,I3,      RTX02550
     X 1X,I2,/,2X,'             WIND     MIXING               AIR     ',RTX02560
     X     '  TURB.     TURB.     VPTG,       VPTG,    DELTA   ',       RTX02570
     X     '   WSPD      WIND',/,                                       RTX02580
     X 2X,'   WIND    SPEED #1   HEIGHT   STABILITY   TEMP   ',         RTX02590
     X     'INTENSITY INTENSITY   PLUME      HCRIT    THETA   ',        RTX02600
     X     ' PROFILE   SPEED #2',/,                                     RTX02610
     X 2X,'DIRECTION  (M/SEC)       (M)      CLASS      (K)    ',       RTX02620
     X     '    (Y)        (Z)     (DEG K/M) (DEG K/M) (DEG/M)  ',      RTX02630
     X     ' EXPONENT   (M/SEC)',//,                                    RTX02640
     X 5X,F4.0,5X,F5.2,5X,F5.0,8X,I1,6X,F6.2,4X,6(F6.4,A1,3X),F5.2,A1) RTX02650
      IF(IPRINT.EQ.1) WRITE(6,19)                                       RTX02660
   19 FORMAT(/,' * FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL ',RTX02670
     X 'INPUT NOT USED IN THIS RUN')                                    RTX02680
 3500 CALL CONC    @ DO CONCENTRATION CALCULATIONS                      RTX02690
      GO TO 1000                                                        RTX02700
C                                                                       RTX02710
C                                                                       RTX02720
 5000 RETURN                                                            RTX02730
C                                                                       RTX02740
 8000 WRITE(6,20) IYR,IDAY,IHR,JYR,JDAY,JHR                             RTX02750
   20 FORMAT('   HOUR OF METEOROLOGICAL DATA (',I2,1X,I3,1X,I2,         RTX02760
     X ') DOES NOT AGREE WITH HOUR OF EMISSIONS DATA (',I2,1X,I3,1X,    RTX02770
     X I2,')')                                                          RTX02780
      WRITE(6,21)                                                       RTX02790
   21 FORMAT(' * FATAL ERROR *',//,' EXECUTION TERMINATED DUE TO ',     RTX02800
     X 'TIME DISAGREEMENT BETWEEN METEOROLOGICAL AND EMISSIONS DATA.') RTX02810
      STOP                                                              RTX02820
C                                                                       RTX02830
 9000 WRITE(6,25) LASTYR,LASTDA,LASTHR                                  RTX02840
   25 FORMAT('   FORMAT ERROR IN METEOROLOGICAL DATA.  LAST GOOD ',     RTX02850
     X  'HOUR WAS ',I2,1X,I3,1X,I2)                                     RTX02860
        GO TO 9800                                                      RTX02870
C                                                                       RTX02880
 9500   WRITE(6,27) LASTYR,LASTDA,LASTHR                                RTX02890
   27   FORMAT('   FORMAT ERROR IN EMISSIONS DATA.  LAST GOOD ',        RTX02900
     X  'HOUR WAS ',I2,1X,I3,1X,I2)                                     RTX02910
C                                                                       RTX02920
 9800   WRITE(6,28)                                                     RTX02930
   28   FORMAT(' * FATAL ERROR *',//,' EXECUTION TERMINATED DUE TO ',   RTX02940
     X  'FORMAT ERROR IN INPUT DATA.')                                  RTX02950
        STOP                                                            RTX02960
        END                                                             RTX02970
        SUBROUTINE CONC
C
C***********************************************************************
C
C       THIS SUBROUTINE COMPUTES CONCENTRATIONS AT ALL RECEPTORS
C       FOR ALL STACKS, GIVEN A SET OF METEOROLOGICAL CONDITIONS
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C*********************************************************************
C
C*******************************************************
C
C      COMMON BLOCK FOR STACK SPECIFIC DATA
C
C*******************************************************
       COMMON /STACKS/
     X                 SNAME(35),   @STACK NAMES
     X                 HEIGHT(35),  @STACK HEIGHT (M)
     X                 DIAMTR(35),  @STACK DIAMETER (M)
     X                 EXITVL(35),  @STACK EXIT VELOCITY (M/SEC)
     X                 STEMP(35),   @STACK GAS EXIT TEMP (DEG K)
     X                 EMISR(35),   @EMISSION RATE  (G/SEC)
     X                 UTMX,        @X-COORDINATE FOR ALL STACKS
     X                 UTMY,        @Y-COORDINATE FOR ALL STACKS
     X                 BASEHT,      @BASE HEIGHT FOR ALL STACKS
     X                 NS,          @NUMBER OF STACKS
     X                 EMSLBL       @LABEL FOR POLLUTANT
C
C*******************************************************
C
C      COMMON BLOCK FOR RECEPTOR SPECIFIC DATA
C
C*******************************************************
C
       COMMON /PLACE/ RX(400),RY(400),RZ(400),NR
C              RX             @RECEPTOR X-COORDINATES, METERS
C              RY             @RECEPTOR Y-COORDINATES,  METERS
C              RZ             @RECEPTOR TERRAIN HEIGHTS, USER UNITS
C
C*******************************************************
C
C      COMMON BLOCK FOR HOURLY METEOROLOGICAL DATA
C
C*******************************************************
       COMMON /MET/
     X                WDIR,         @ WIND DIRECTION
     X                WSPD,         @ WIND SPEED #1 (M/SEC)
     X                DMX,          @ MIXING HEIGHT (M)
     X                IST,          @ STABILITY CLASS
     X                TEMP,         @ AMBIENT TEMPERATURE (DEG K)
     X                XIY,          @ TURBULENCE, Y-COMPONENT
     X                XIZ,          @ TURBULENCE, Z-COMPONENT
     X                PRVPTG,       @ PLUME RISE VPTG
     X                HCVPTG,       @ HCRIT VPTG
     X                  DTHETA,       @ HORIZONTAL WIND DIRECTION SHEAR   CON00580
     X                  EPS,          @ WIND SPEED PROFILE EXPONENT       CON00590
     X                  WSPD2         @ WIND SPEED #2 (M/SEC)             CON00600
C                                                                         CON00610
C*****************************************************                    CON00620
C                                                                         CON00630
C      COMMON BLOCK FOR MODEL PARAMETERS AND SWITCHES                     CON00640
C                                                                         CON00650
C*****************************************************                    CON00660
C                                                                         CON00670
       DIMENSION AY(6,3),BY(6,3),CY(6,3),                                 CON00680
     X         AZ(6,3),BZ(6,3),CZ(6,3)                                    CON00690
       COMMON /PR001/ HSCALE                                              CON00700
       COMMON /PR002/ VSCALE                                              CON00710
       COMMON /PR003/ USCALE                                              CON00720
       COMMON /PR004/ ZWIND1,ZWIND2,IDILUT,ZA                             CON00730
       COMMON /PR005/ EXPON(6)                                            CON00740
       COMMON /PR006/ ICOEF                                               CON00750
       COMMON /PR007/ AY, BY, CY, XY1,XY2                                 CON00760
       COMMON /PR008/ AZ, BZ, CZ, XZ1,XZ2                                 CON00770
       COMMON /PR009/ IPPP,PPVPTG                                         CON00780
       COMMON /PR010/ IBUOY,ALPHA                                         CON00790
       COMMON /PR011/ IDMX                                                CON00800
       COMMON /PR012/ ITRANS                                              CON00810
       COMMON /PR013/ TERCOR(6)                                           CON00820
       COMMON /PR014/ RVPTG(2)                                            CON00830
       COMMON /PR015/ ITIPD                                               CON00840
       COMMON /PR016/ IY                                                  CON00850
       COMMON /PR017/ IZ                                                  CON00860
       COMMON /PR018/ IRVPTG                                              CON00870
       COMMON /PR019/ IHVPTG                                              CON00880
       COMMON /PR020/ ISHEAR,SHCOEF                                       CON00890
       COMMON /PR021/ IEPS                                                CON00900
       COMMON /PR022/ IREFL                                               CON00910
       COMMON /PR023/ IHORIZ,SECTOR(6)                                    CON00920
       COMMON /PR024/ IEMIS                                               CON00930
       COMMON /PR025/ IVERB                                               CON00940
C                                                                         CON00950
      REAL CHI(400)                                                       CON00960
C                                                                         CON00970
      IF(IEPS.EQ.0) EPS = EXPON(IST)                                      CON00980
      IF(IRVPTG.EQ.0.AND.IST.GT.4) PRVPTG = RVPTG(IST-4)                  CON00990
      IF(IHVPTG.EQ.0.AND.IST.GT.4) HCVPTG = RVPTG(IST-4)                  CON01000
C                                                                         CON01010
      DO 1000 I = 1,400                                                   CON01020
 1000 CHI(I) = 0.0                                                        CON01030
      X=UTMX          @STACK X COORDINATE                                 CON01040
      Y=UTMY          @STACK Y COORDINATE                                 CON01050
C                                                                         CON01060
      DO 4000 IS = 1,NS                                                   CON01070
      HT=HEIGHT(IS)   @HEIGHT OF STACK                                    CON01080
      DIA=DIAMTR(IS)        @STACK DIAMETER                               CON01090
      EMIS = EMISR(IS)          @EMISSION RATE IN G/SEC                   CON01100
      XVEL = EXITVL(IS)         @EXIT VELOCITY IN M/SEC                   CON01110
       ST = STEMP(IS)        @ STACK TEMPERATURE IN DEG K                 CON01120
C                                                                         CON01130
      IF(EMIS.LE.0.0) GO TO 4000                       @ NO EMISSIONS     CON01140
```

```
      GO TO 190                                                           PGT00580
C         STABILITY B                                                     PGT00590
   40 TH=(18.333-1.8096*ALOG(XY))/57.2958                                 PGT00600
      IF (X.GT.35.) GO TO 170                                             PGT00610
      DO 50 ID=1,2                                                        PGT00620
      IF (X.GE.XB(ID)) GO TO 60                                           PGT00630
   50 CONTINUE                                                            PGT00640
      ID=3                                                                PGT00650
   60 SZ=AB(ID)*X**BB(ID)                                                 PGT00660
      GO TO 180                                                           PGT00670
C         STABILITY C                                                     PGT00680
   70 TH=(12.5-1.0857*ALOG(XY))/57.2958                                   PGT00690
      SZ=61.141*X**0.91465                                                PGT00700
      GO TO 180                                                           PGT00710
C         STABILITY D                                                     PGT00720
   80 TH=(8.3333-0.72382*ALOG(XY))/57.2958                                PGT00730
      DO 90 ID=1,5                                                        PGT00740
      IF (X.GE.XD(ID)) GO TO 100                                          PGT00750
   90 CONTINUE                                                            PGT00760
      ID=6                                                                PGT00770
  100 SZ=AD(ID)*X**BD(ID)                                                 PGT00780
      GO TO 180                                                           PGT00790
C         STABILITY E                                                     PGT00800
  110 TH=(6.25-0.54287*ALOG(XY))/57.2958                                  PGT00810
      DO 120 ID=1,8                                                       PGT00820
      IF (X.GE.XE(ID)) GO TO 130                                          PGT00830
  120 CONTINUE                                                            PGT00840
      ID=9                                                                PGT00850
  130 SZ=AE(ID)*X**BE(ID)                                                 PGT00860
      GO TO 180                                                           PGT00870
C         STABILITY F                                                     PGT00880
  140 TH=(4.1667-0.36191*ALOG(XY))/57.2958                                PGT00890
      DO 150 ID=1,9                                                       PGT00900
      IF (X.GE.XF(ID)) GO TO 160                                          PGT00910
  150 CONTINUE                                                            PGT00920
      ID=10                                                               PGT00930
  160 SZ=AF(ID)*X**BF(ID)                                                 PGT00940
      GO TO 180                                                           PGT00950
  170 SZ=5000.                                                            PGT00960
      GO TO 190                                                           PGT00970
  180 IF (SZ.GT.5000.) SZ=5000.                                           PGT00980
  190 SY=465.116*XY*SIN(TH)/COS(TH)                                       PGT00990
C         465.116 = 1000. (M/KM) / 2.15                                   PGT01000
      RETURN                                                              PGT01010
C                                                                         PGT01020
      END                                                                 PGT01030
```

```
C                                                                       CON01150
C     DETERMINE MAXIMUM HEIGHT TO WHICH WIND SPEED IS ALLOWED TO        CON01160
C     INCREASE ACCORDING TO POWER LAW FORMULA                           CON01170
C                                                                       CON01180
      IF(IST.GE.4) GO TO 1050                                           CON01190
      HMX1 = AMAX1(0.1*DMX,ZWIND1)                                      CON01200
      HMX2 = AMAX1(0.1*DMX,ZWIND2)                                      CON01210
      HMAX1 = AMIN1(HT-ZA,HMX1)                                         CON01220
      GO TO 1100                                                        CON01230
C                                                                       CON01240
 1050 WS10 = WSPD*(10./ZWIND1)**EPS                                     CON01250
      HMX1 = AMAX1(200.*WS10,ZWIND1)                                    CON01260
      HMX2 = AMAX1(200.*WS10,ZWIND2)                                    CON01270
      HMAX1 = AMIN1(HT-ZA,HMX1)                                         CON01280
      IF(HMAX1.LT.1.0) HMAX1 = 1.0                                      CON01290
C                                                                       CON01300
 1100 UTOP = WSPD*(HMAX1/ZWIND1)**EPS     @STACK TOP WIND VEL.          CON01310
      IF(UTOP.LT.1.0) UTOP = 1.0                                        CON01320
      IPRINT = 0                                                        CON01330
C                                                                       CON01340
      DO 3500 IR = 1,NR                                                 CON01350
C                                                                       CON01360
       IZZ=0                                                            CON01370
       SN = SIN(0.0174533 * WDIR)                                       CON01380
       CS = COS(0.0174533 * WDIR)                                       CON01390
       CALL PSRCE(X,Y,RX(IR),RY(IR),SN,CS,IZZ,YCROSS,XP) @ HORIZ GEOM   CON01400
       IF(IZZ.EQ.1) GO TO 3500                                          CON01410
C                                                                       CON01420
C     COMPUTE PLUME RISE                                                CON01430
C                                                                       CON01440
       CALL PRISE(IST,UTOP,XP,XVEL,DIA,ST,TEMP,PRVPTG,RISE,XFIN,        CON01450
     X HFIN,FLUX)      @   CALCULATE PLUME RISE                         CON01460
       DELTAH=RISE                                                      CON01470
       H=DELTAH+HT                                                      CON01480
C                                                                       CON01490
C     COMPUTE DILUTION WIND SPEED                                       CON01500
C                                                                       CON01510
      IF(IDILUT.GE.1) GO TO 1200                                        CON01520
      UDILUT = UTOP    @ SET DILUTION WIND SPEED TO THAT AT STACK TOP   CON01530
      GO TO 1500                                                        CON01540
C                                                                       CON01550
 1200 IF(IDILUT.EQ.2) GO TO 1300                                        CON01560
      HMAX2 = AMIN1(HT-ZA+RISE,HMX1)                                    CON01570
      HMAX3 = AMIN1(HT-ZA+HFIN,HMX1)                                    CON01580
      IF(HMAX2.LT.1.0) HMAX2 = 1.0                                      CON01590
      IF(HMAX3.LT.1.0) HMAX3 = 1.0                                      CON01600
      UDILUT = WSPD*((HMAX2)/ZWIND1)**EPS @ EXTRAPOLATE SPEED #1        CON01610
      UDILF = WSPD*((HMAX3)/ZWIND1)**EPS @ EXTRAPOLATE TO FINAL RISE    CON01620
      GO TO 1500                                                        CON01630
C                                                                       CON01640
 1300 HMAX2 = AMIN1(HT-ZA+RISE,HMX2)                                    CON01650
      HMAX3 = AMIN1(HT-ZA+HFIN,HMX2)                                    CON01660
      IF(HMAX2.LT.1.0) HMAX2 = 1.0                                      CON01670
      IF(HMAX3.LT.1.0) HMAX3 = 1.0                                      CON01680
      UDILUT = WSPD2*((HMAX2)/ZWIND2)**EPS @ EXTRAPOLATE SPEED #2       CON01690
      UDILF = WSPD2*((HMAX3)/ZWIND2)**EPS @ EXTRAPOLATE TO FINAL RISE   CON01700
C                                                                       CON01710
```

```
 1500 IF(UDILUT.LT.1.0) UDILUT = 1.0
      IF(UDILF.LT.1.0) UDILF = 1.0
      CALL SIGMAY(IST,DTHETA,XP,YCROSS,RISE,XIY,SIGY,
     X SIGYA,SIGYB,SIGYC,HDF)
      IF(HDF.LT.1.0E-20) GO TO 3500   @ ESSENTIALLY ZERO CONCENTRATION
      CALL SIGMAZ(IST,XP,RISE,XIZ,SIGZ,SIGZA,SIGZB)
C
      PESS = PPVPTG * 9.806/TEMP
      PUNCH = 0.0
      P=PENETR(DMX,HT,FLUX,PUNCH,HFIN,UTOP,PESS,IPPP)
C
      IF(P.LT.1.0) GO TO 1700    @ IF P=1, A COMPLETE PUNCH THROUGH
      HCRIT = 0.0    @   NOT YET DEFINED, BUT NOT IMPORTANT
      IF(IVERB.EQ.1.AND.IPRINT.EQ.0)
     X WRITE(6,5) IS,EMIS,XVEL,ST,HCRIT,UTOP,FLUX,HFIN,XFIN,P
      GO TO 4000    @ NO GROUND-LEVEL CONCENTRATIONS FOR THIS STACK
C
 1700 THT = RZ(IR) - BASEHT
C
      CALL VERT(H,THT,XP,RISE,UTOP,SIGZ,HCRIT,HPLUME,V,RVDF,R)
C
      IF(IVERB.EQ.0 .OR. IPRINT.EQ.1) GO TO 2000
      WRITE(6,5) IS,EMIS,XVEL,ST,HCRIT,UTOP,FLUX,HFIN,XFIN,P
    5 FORMAT(/,' STACK #',I2,':  EMISSIONS = ',F8.2,' G/SEC, ',
     X ' EXIT VELOCITY = ',F6.2,' M/SEC,  STACK GAS TEMP = ',F7.2,
     X ' DEG K,  HCRIT = ',F8.2,' M',/,' UTOP = ',F5.2,' M/SEC,  ',
     X ' FLUX = ',F9.2,' M**4/S**3,  FINAL RISE = ',F7.2,
     X ' M,  DISTANCE TO FINAL RISE = ',F8.2,' M,  PEN. FRAC. = ',
     X F4.2)
C
      IF(IDILUT.GE.1) WRITE(6,6) UDILF
    6 FORMAT(' DILUTION SPEED (AT FINAL RISE PLUME HEIGHT) = ',F5.2,
     X ' M/SEC')
C
      WRITE(6,7)
    7 FORMAT(//,19X,'HT',77X,'CONVENTIONAL REFLECTION',/,18X,'ABOVE ',
     X 'PLUME HT  PLUME HT',11X,'SIGMA-Y',16X,'SIGMA-Z',8X,'HORIZ.   ',
     X 'VERTICAL    VERTICAL',7X,'CHI',/,18X,'STACK  BEFORE  CORRECTED',
     X 49X,'DIST.      DIST.       DIST.',/,
     X ' REC   X     Y   BASE  TERRAIN  BY TERRAIN  AMBIENT BUOY ',
     X 'SHEAR  TOTAL AMBIENT BUOY  TOTAL FACTOR    FACTOR      FACTOR ',
     X 7X,'(UG/',/,' #   (KM)  (KM)   (M)    (M)       (M)        ',
     X '(M)   (M)   (M)    (M)    (M)   (M)    (M)  (1/M)     (1/M)   ',
     X '    (1/M)      R  M**3)',/)
C
      IPRINT = 1
 2000 CVDF = V     @ CONVENTIONAL VERTICAL DISTRIBUTION FUNCTION
C
      VDF = AMIN1(CVDF,RVDF)
      SCHI = EMIS * HDF * VDF/UDILUT * (1.0-P)
C
      IF(IVERB.EQ.0) GO TO 2500
      SCHI6 = SCHI * 1000000.
      XKM = XP/1000.
      YKM = YCROSS/1000.
C
      WRITE(6,9) IR,XKM,YKM,THT,H,HPLUME,SIGYA,
     X SIGYB,SIGYC,SIGY,SIGZA,SIGZB,SIGZ,HDF,CVDF,RVDF,R,SCHI6
    9  FORMAT(1X,I3,1X,F5.2,1X,F6.2,1X,F5.0,1X,F8.2,2X,F8.2,3X,
     X F6.1,F6.1,F6.0,F7.1,1X,F6.1,F6.1,F7.1,
     X 1X,F6.5,2X,E10.5,2X,E10.5,1X,F4.2,F6.0)
C
 2500  CHI(IR) = CHI(IR) + SCHI
C
 3500  CONTINUE
 4000  CONTINUE
C
       CALL WRCONC(CHI,NR)     @ OUTPUT CONCENTRATIONS FOR THIS HOUR
C
       RETURN
       END
```

```
      SUBROUTINE PRISE(IST,UTOP,XP,XVEL,DIA,STEMP,TEMP,PRVPTG,RISE,
     X  XFIN,HFIN,FLUX)
C
C*********************************************************************
C   ..  -
C       BRIGGS PLUME RISE
C       TRANSITIONAL AND EQUILIBRIUM PLUME RISE ARE CALCULATED
C
C*********************************************************************
C
C       UNITS USED ARE METRIC
C
C      IST       STABILITY CLASS
C      UTOP      STACK TOP WIND SPEED (M/SEC)
C      XP        DOWNWIND DISTANCE (M)
C      XVEL      STACK EXIT VELOCITY (M/SEC)
C      DIA       STACK DIAMETER (M)
C      STEMP     STACK TEMPERATURE (K)
C      TEMP      AMBIENT TEMPERATURE (K)
C      PRVPTG    VERT. POTENTIAL TEMP. GRADIENT FOR PLUME RISE (DEG K/M)
C      RISE      PLUME RISE AT DISTANCE XP  (M)
C      XFIN      DISTANCE TO FINAL RISE  (M)
C      HFIN      FINAL RISE  (M)
C      FLUX      BUOYANCY FLUX (M**4/S**3)
C
C*********************************************************************
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C*********************************************************************
C
      COMMON /PR012/ ITRANS
      COMMON /PR015/ ITIPD
C
      DELT = STEMP - TEMP
      IF(DELT.GE.0.1) GO TO 100
      STEMP = TEMP + 0.1
      DELT = 0.1
  100 FLUX = 2.4515*XVEL*DIA*DIA*(DELT)/STEMP
      F33=FLUX**.33333
      ESS = 0.
      IF(IST.GT.4) ESS=PRVPTG * 9.806/TEMP
C
C
C     IF A STABLE STABILITY, COMPUTE NEUTRAL RISE ANYWAY TO CHECK
C     WHETHER OR NOT STABLE RISE IS LESS THAN NEUTRAL RISE
C
C      UNSTABLE OR NEUTRAL RISE
C
      XSTAR=AMIN1(34.*FLUX**.4,14.*FLUX**.625)
      XFIN = 3.5*XSTAR
      X = XP
      IF(ITRANS.EQ.0) X = XFIN
      RISE = (1.6*F33*AMIN1(X,XFIN)**.66667)/UTOP
      HFIN = (1.6*F33*XFIN**.66667)/UTOP
      IF(IST.LE.4.OR.ESS.LE.0.0) GO TO 600  @ NON-STABLE RISE
      RISE1 = RISE                                                      RIS00580
      XFIN1 = XFIN                                                      RIS00590
C                                                                       RIS00600
C     STABLE RISE SECTION -- COMPUTE FINAL RISE FIRST                   RIS00610
C                                                                       RIS00620
      RISE2 = 5.0*FLUX**0.25/(ESS**.375)  @ CALM CASE                   RIS00630
C                                                                       RIS00640
      RISE3 = 2.6*(F33/(UTOP*ESS)**.3333) @ NON-CALM CASE               RIS00650
C                                                                       RIS00660
      IF(RISE3.LE.RISE2) GO TO 300  @ TAKE LOWEST OF THE 3 RESULTS      RIS00670
C                                                                       RIS00680
      STRISE = RISE2                                                    RIS00690
      STHFIN = RISE2                                                    RIS00700
      GO TO 400                                                         RIS00710
C                                                                       RIS00720
  300 STRISE = RISE3                                                    RIS00730
      STHFIN = RISE3                                                    RIS00740
C                                                                       RIS00750
C     CHECK FOR TRANSITIONAL RISE                                       RIS00760
C                                                                       RIS00770
  400 STXFIN=2.07*UTOP/SQRT(ESS)                                        RIS00780
      IF(XP.GE.STXFIN .OR. ITRANS.EQ.0) GO TO 500                       RIS00790
      STRISE = 1.6*F33*XP**.6667/UTOP   @ GRADUAL RISE                  RIS00800
C                                                                       RIS00810
  500 IF(RISE1.LE.STRISE) GO TO 600  @ NEUTRAL RISE; HFIN,XFIN,RISE DEFRIS00820
      RISE = STRISE                                                     RIS00830
      XFIN = STXFIN                                                     RIS00840
      HFIN = STHFIN                                                     RIS00850
C                                                                       RIS00860
C     STACK-TIP DOWNWASH SECTION                                        RIS00870
C                                                                       RIS00880
  600 IF(ITIPD.EQ.0) RETURN                                             RIS00890
      A = 2.0*AMAX1(0.0,1.5-XVEL/UTOP)                                  RIS00900
      RISE = RISE - A*DIA - SQRT(8.*A/3.1459) * DIA                     RIS00910
      HFIN = HFIN - A*DIA - SQRT(8.*A/3.1459) * DIA                     RIS00920
      RETURN                                                            RIS00930
      END                                                               RIS00940
      FUNCTION PENETR(DMX,HT,F,PUNCH,DH,U,S,MODE)
C*******************************************************************
C
C  THIS SUBROUTINE DETERMINES IF
C  1) THE PLUME PUNCHES THRU THE INVERSION (PENETR=1), OR
C  2) THE PLUME IS TRAPPED BELOW THE INVERSION (PENETR=0), OR
C  3) THE PLUME PARTIALLY PENETRATES THE INVERSION (PENETR=FRACTION)
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C
C*******************************************************************
C
      REAL HT
      BETA=0.6
      RMEFM=2.25
      IF(MODE.NE.0) GO TO 3000
C
C     ALL OR ZERO PENETRATION
C
      IF(DMX+PUNCH.GE.HT+DH) GO TO 1000
      PENETR=1.
      GO TO 7000
 1000 PENETR=0.
      GO TO 7000
C
C     PARTIAL PENETRATION POSSIBLE
C
 3000 CONTINUE
      ZB=DMX-HT
      IF(ZB.GE.1.E-15) GO TO 4000
      PENETR=1.
      RETURN
 4000 CONTINUE
      C=F*RMEFM*2./(BETA*BETA*U*S*ZB*ZB*ZB)
      Q=C*(C/4.-1./27.)
      IF(Q.LT.0.) GO TO 5000
      SQRTQ=SQRT(Q)
      T=C/2.-1./27.
      X=(T+SQRTQ)**.333333+(T-SQRTQ)**.333333+.333333
      GO TO 6000
 5000 CONTINUE
      X=.666666*COS(.333333*ACOS(13.5*C-1.))+.333333
 6000 CONTINUE
      Y=1./AMIN1(X,DH/ZB)
      PENETR=AMAX1(0.,AMIN1(1.,1.5-Y))
 7000 CONTINUE
      RETURN
      END
```

```
        SUBROUTINE PSRCE(SX,SY,RX,RY,SND,CSD,IZZ,Y,XP)
C
C******************************************************************
C
C       POINT SOURCE HORIZONTAL GEOMETRY
C
C       SX      -STACK X COORDINATE (M)
C       SY      -STACK Y COORDINATE (M)
C       RX      -RECEPTOR X COORDINATE (M)
C       RY      -RECEPTOR Y COORDINATE (M)
C       SND     -SINE OF WIND DIRECTION ANGLE(DEG. FROM N)
C       CSD     -COSINE OF WIND DIRECTION ANGLE
C       IZZ     -IZZ = 1 IF AN UPWIND RECEPTOR
C       Y       - CROSSWIND DISTANCE TO SOURCE
C       XP      - DOWNWIND DISTANCE (METERS) (RETURNED)
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C********************************************************************
C
        X1 = (SX-RX)
        Y1 = (SY-RY)
C
        XP = Y1*CSD+X1*SND        @DOWNWIND DISTANCE TO RECEPTOR
C
        IF( XP .GT. 0.) GO TO 10        @RECEPTOR IS UPWIND
        IZZ=1
        RETURN
   10   CONTINUE
C
        Y = Y1*SND-X1*CSD         @DISTANCE FROM CENTER LINE
C
        IF( XP .LT. 10.) XP = 10.
C
        RETURN
        END
```

```
      SUBROUTINE SIGMAY(IST,DTHETA,XP,Y,RISE,XIY,SIGY,SIGYA,SIGYB,
     X SIGYC,HDF)
C
C***********************************************************************
C
C     THIS ROUTINE COMPUTES SIGMA-Y AND THE HORIZONTAL DISTRIBUTION
C     FUNCTION.
C
C     IST      - STABILTY CLASS
C     DTHETA   - WIND DIRECTION SHEAR, IN DEGREES PER METER
C     XP       - DOWNWIND DISTANCE (METERS)
C     Y        - CROSSWIND DISTANCE (METERS)
C     RISE     - PLUME RISE (METERS)
C     XIY      - TURBULENCE INTENSITY (Y-COMPONENT)
C     SIGY     - SIGMA-Y
C     SIGYA    - SIGMA-Y, ATMOSPHERIC DISPERSION COMPONENT
C     SIGYB    - SIGMA-Y, BUOYANCY ENHANCEMENT COMPONENT
C     SIGYC    - SIGMA-Y, SHEAR COMPONENT
C     HDF      - HORIZONTAL DISTRIBUTION FUNCTION IN GAUSSIAN EQUATION
C
C     ERT, INC.
C     696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C     RTDM
C***********************************************************************
C
      DIMENSION AY(6,3),BY(6,3),CY(6,3)
      COMMON /PR006/ ICOEF
      COMMON /PR007/ AY, BY, CY, XY1,XY2
      COMMON /PR010/ IBUOY,ALPHA
      COMMON /PR016/ IY
      COMMON /PR020/ ISHEAR,SHCOEF
      COMMON /PR023/ IHORIZ,SECTOR(6)
C
      TMAX = 9.21
C
      IF(IY.EQ.0) GO TO 200
C
C     USE TURBULENCE INTENSITY VALUE
C
      SIGYA = XIY * XP/SQRT(1.0 + 0.0001*XP)
      IF(XP.GT.10000.) SIGYA = XIY * XP/1.4142
      GO TO 300
C
C     STABILITY CLASS DETERMINATION OF SIGMA-Y
C
  200 IF(ICOEF.EQ.1) GO TO 250   @ SIGY = A * X**B  + C
      IF(ICOEF.EQ.2) GO TO 220    @ PASQUILL-GIFFORD
      CALL BRIGGS(IST,XP,SIGYA,SIGZA)   @ BRIGGS RURAL
      GO TO 300
  220 CALL PGYZ(XP,IST,SIGYA,SIGZA)
      GO TO 300
C
  250 K=3
      IF(XP.LE.XY2)K=2
      IF(XP.LE.XY1)K=1
      SIGYA=AY(IST,K)*(XP)**BY(IST,K)+CY(IST,K)
```

```
C
C       CONSIDER BUOYANCY-ENHANCED DISPERSION
C
  300   SIGYB = 0.0
        IF(IBUOY.EQ.0) GO TO 400
        SIGYB = RISE/ALPHA
C
C       CONSIDER ENHANCEMENT OF SIGMA-Y BY WIND DIRECTION SHEAR
C
  400   SIGYC = 0.0
        IF(ISHEAR.EQ.0) GO TO 500
        SIGYC = SHCOEF * DTHETA * 0.01745 * RISE * XP
C
  500   SIGY=SQRT(SIGYA*SIGYA + SIGYB*SIGYB + SIGYC*SIGYC)
C
C         COMPUTE HDF
C
        IF(IHORIZ.EQ.1.OR.(IHORIZ.EQ.3.AND.IST.LT.5)) GO TO 700
C
C        SECTOR AVERAGING
C
        SW =  2.0 * XP * TAN(SECTOR(IST)/114.59156) @ SECTOR WIDTH IN M
        HDF = 1.0/SW   @  UNIFORM HORIZONTAL PROFILE WITHIN SECTOR
        IF(ABS(Y).GT.SW/2.0) HDF = 0.0  @ IF OUTSIDE SECTOR, ZERO CONC
        RETURN
C
C       OFF-CENTERLINE
C
  700   HDF = 0.3989423/SIGY    @  1/ROOT(2*PI) = .3989423
        ARG=.5*(Y/SIGY)**2
        IF (ARG.GT.TMAX) HDF = 0.
        IF (ARG.LE.TMAX) HDF = HDF*EXP(-ARG)
C
        RETURN
        END
```

```
      SUBROUTINE SIGMAZ(IST,XP,RISE,XIZ,SIGZ,SIGZA,SIGZB)
C
C*********************************************************************
C
C     THIS ROUTINE COMPUTES SIGMA-Z.
C
C     IST     - STABILTY CLASS
C     XP      - DOWNWIND DISTANCE (METERS)
C     RISE    - PLUME RISE (METERS)
C     XIZ     - TURBULENCE INTENSITY (Z-COMPONENT)
C     SIGZ    - SIGMA-Z
C     SIGZA   - SIGMA-Z, ATMOSPHERIC DISPERSION COMPONENT
C     SIGZB   - SIGMA-Z, BUOYANCY ENHANCEMENT COMPONENT
C
C     ERT, INC.
C     696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C     RTDM
C*********************************************************************
C
      DIMENSION AZ(6,3),BZ(6,3),CZ(6,3)
      COMMON /PR006/ ICOEF
      COMMON /PR008/ AZ, BZ, CZ, XZ1,XZ2
      COMMON /PR010/ IBUOY,ALPHA
      COMMON /PR017/ IZ
C
C
      IF(IZ.EQ.0) GO TO 1200
C
C     USE TURBULENCE INTENSITY VALUE
C
      IF(IST.LE.3) SIGZA = XIZ * XP
      IF(IST.EQ.4) SIGZA = XIZ * XP/SQRT(1.0 + 0.0015*XP)
      IF(IST.GT.4) SIGZA = XIZ * XP/(1.0 + 0.0003*XP)
      GO TO 1300
C
C     STABILITY CLASS DETERMINATION OF SIGMA-Z
C
 1200 IF(ICOEF.EQ.1) GO TO 1250   @ SIGZ = A * X**B  + C
      IF(ICOEF.EQ.2) GO TO 1220    @ PASQUILL-GIFFORD
      CALL BRIGGS(IST,XP,SIGYA,SIGZA)   @ BRIGGS RURAL
      GO TO 1300
 1220 CALL PGYZ(XP,IST,SIGYA,SIGZA)
      GO TO 1300
C
 1250 K=3
      IF(XP.LE.XZ2)K=2
      IF(XP.LE.XZ1)K=1
      SIGZA=AZ(IST,K)*(XP)**BZ(IST,K)+CZ(IST,K)
C
C     CONSIDER BUOYANCY-ENHANCED DISPERSION
C
 1300 SIGZB = 0.0
      IF(IBUOY.EQ.0) GO TO 1400
      SIGZB = RISE/ALPHA
C
 1400 SIGZ=SQRT(SIGZA*SIGZA + SIGZB*SIGZB)
```

```
      RETURN                                                            SGZ00580
      END                                                               SGZ00590
      SUBROUTINE BRIGGS(IST,XP,SIGYA,SIGZA)
C
C*********************************************************************
C
C     THIS ROUTINE COMPUTES SIGMA-Y AND SIGMA-Z (ATMOSPHERIC
C     DISPERSION COMPONENTS) USING BRIGGS RURAL FORMULAS (1974)
C
C     IST     - STABILTY CLASS
C     XP      - DOWNWIND DISTANCE (METERS)
C     SIGYA   - SIGMA-Y, ATMOSPHERIC DISPERSION COMPONENT
C     SIGZA   - SIGMA-Z, ATMOSPHERIC DISPERSION COMPONENT
C
C     ERT, INC.
C     696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C     RTDM
C*********************************************************************
C
      GO TO (1000,2000,3000,4000,5000,6000), IST
C
 1000 SIGYA = 0.22 * XP/SQRT(1.0 + 0.0001*XP)
      SIGZA = 0.20 * XP
      RETURN
C
 2000 SIGYA = 0.16 * XP/SQRT(1.0 + 0.0001*XP)
      SIGZA = 0.12 * XP
      RETURN
C
 3000 SIGYA = 0.11 * XP/SQRT(1.0 + 0.0001*XP)
      SIGZA = 0.08 * XP/SQRT(1.0 + 0.0002*XP)
      RETURN
C
 4000 SIGYA = 0.08 * XP/SQRT(1.0 + 0.0001*XP)
      SIGZA = 0.06 * XP/SQRT(1.0 + 0.0015*XP)
      RETURN
C
 5000 SIGYA = 0.06 * XP/SQRT(1.0 + 0.0001*XP)
      SIGZA = 0.03 * XP/(1.0 + 0.0003*XP)
      RETURN
C
 6000 SIGYA = 0.04 * XP/SQRT(1.0 + 0.0001*XP)
      SIGZA = 0.016 * XP/(1.0 + 0.0003*XP)
      RETURN
      END
```

```
C
      SUBROUTINE PGYZ(XMETER,KST,SY,SZ)
C
C*********************************************************************
C
C      THIS SUBROUTINE IS PART OF THE EPA MPTER MODEL CODE.
C
C        VERTICAL DISPERSION PARAMETER VALUE, SZ DETERMINED BY
C         SZ = A * X ** B WHERE A AND B ARE FUNCTIONS OF BOTH STABILITY
C         AND RANGE OF X.
C
C       X = XMETER/1000.
C       KST = STABILITY CLASS
C
C        HORIZONTAL DISPERSION PARAMETER VALUE, SY DETERMINED BY
C         LOGARITHMIC INTERPOLATION OF PLUME HALF-ANGLE ACCORDING TO
C         DISTANCE AND CALCULATION OF 1/2.15 TIMES HALF-ARC LENGTH.
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C
C*********************************************************************
C
      DIMENSION XA(7), XB(2), XD(5), XE(8), XF(9), AA(8), BA(8), AB(3),
     1BB(3), AD(6), BD(6), AE(9), BE(9), AF(10), BF(10)
      DATA XA /.5,.4,.3,.25,.2,.15,.1/
      DATA XB /.4,.2/
      DATA XD /30.,10.,3.,1.,.3/
      DATA XE /40.,20.,10.,4.,2.,1.,.3,.1/
      DATA XF /60.,30.,15.,7.,3.,2.,1.,.7,.2/
      DATA AA /453.85,346.75,258.89,217.41,179.52,170.22,158.08,122.8/
      DATA BA /2.1166,1.7283,1.4094,1.2644,1.1262,1.0932,1.0542,.9447/
      DATA AB /109.30,98.483,90.673/
      DATA BB /1.0971,0.98332,0.93198/
      DATA AD /44.053,36.650,33.504,32.093,32.093,34.459/
      DATA BD /0.51179,0.56589,0.60486,0.64403,0.81066,0.86974/
      DATA AE /47.618,35.420,26.970,24.703,22.534,21.628,21.628,23.331,
     X 24.26/
      DATA BE /0.29592,0.37615,0.46713,0.50527,0.57154,0.63077,0.75660,
     X  0.81956,0.8366/
      DATA AF /34.219,27.074,22.651,17.836,16.187,14.823,13.953,13.953,
     X  14.457,15.209/
      DATA BF /0.21716,0.27436,0.32681,0.41507,0.46490,0.54503,0.63227,
     X  0.68465,0.78407,0.81558/
        X = XMETER/1000.
      XY=X
      GO TO (10,40,70,80,110,140), KST
C        STABILITY A
   10 TH=(24.167-2.5334*ALOG(XY))/57.2958
      IF (X.GT.3.11) GO TO 170
      DO 20 ID=1,7
      IF (X.GE,XA(ID)) GO TO 30
   20 CONTINUE
      ID=8
   30 SZ=AA(ID)*X**BA(ID)
```

```
        SUBROUTINE VERT(H,THT,XP,RISE,UTOP,SIGZ,HCRIT,HPLUME,V,
     X  RVDF,R)
C
C*****************************************************************
C
C       THIS ROUTINE COMPUTES THE VERTICAL DISTRIBUTION FUNCTION.
C       THIS CALCULATION INVOLVES COMPUTATION OF THE MODIFIED PLUME
C       HEIGHT AS IT IS AFFECTED BY TERRAIN.  THIS EFFECT IS INFLUENCED
C       BY THE VALUE OF HCRIT, WHICH DEPENDS UPON THE HILL HEIGHT, THE
C       WIND SPEED AND THE VERTICAL POTENTIAL TEMPERATURE GRADIENT.
C
C       A KEY ASPECT OF THIS ROUTINE IS THE CALCULATION OF MAXIMUM
C       CROSSWIND INTEGRATED (MCWI) CONCENTRATION PROFILES AT SEVERAL
C       DOWNWIND DISTANCES, STARTING WHERE REFLECTION FROM THE GROUND IS
C       UNIMPORTANT AND ENDING AT THE RECEPTOR LOCATION.  ACCORDING TO
C       THE SECOND LAW OF THERMODYNAMICS, THE MCWI VALUE MUST DECREASE
C       WITH INCREASING DOWNWIND DISTANCE.  IN THIS ROUTINE, THE MINIMUM
C       VALUE OF THE MCWI CONCENTRATION IS "FROZEN" FOR USE IN THE
C       CALCULATION OF THE VERTICAL DISTRIBUTION FUNCTION PORTION OF THE
C       GAUSSIAN FORMULA.
C
C       H        - PLUME HEIGHT
C       THT      - GROUND HT (ABOVE STACK BASE) AT RECEPTOR
C       XP       - DOWNWIND DISTANCE (METERS)
C       RISE     - PLUME RISE
C       UTOP     - WIND SPEED AT STACK TOP
C       SIGZ     - SIGMA-Z AT RECEPTOR LOCATION
C       HCRIT    - CRITICAL HEIGHT VALUE, BELOW WHICH THE PLUME WILL
C                  IMPINGE A TERRAIN OBSTACLE
C       HPLUME   - FINAL PLUME HEIGHT AFTER TERRAIN ADJUSTMENTS
C       V        - VERTICAL DISTRIBUTION FUNCTION (=1.0/(SQRT(2*PI)*SIGZ)
C                  SERIES OF REFLECTION TERMS IN Z)
C       RVDF     - VERTICAL DISTRIBUTION FUNCTION WITH FROZEN R
C       R        - FROZEN REFLECTION FACTOR
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C********************************************************************
C
C*****************************************************
C
C      COMMON BLOCK FOR STACK SPECIFIC DATA
C
C*****************************************************
       COMMON /STACKS/
     X                 SNAME(35),   @STACK NAMES
     X                 HEIGHT(35),  @STACK HEIGHT (M)
     X                 DIAMTR(35),  @STACK DIAMETER (M)
     X                 EXITVL(35),  @STACK EXIT VELOCITY (M/SEC)
     X                 STEMP(35),   @STACK GAS EXIT TEMP (DEG K)
     X                 EMISR(35),   @EMISSION RATE  (G/SEC)
     X                 UTMX,       @X-COORDINATE FOR ALL STACKS
     X                 UTMY,       @Y-COORDINATE FOR ALL STACKS
     X                 BASEHT,     @BASE HEIGHT FOR ALL STACKS
     X                 NS,         @NUMBER OF STACKS
     X                 EMSLBL       @LABEL FOR POLLUTANT                VRT00580
C                                                                       VRT00590
C*****************************************************                  VRT00600
C                                                                       VRT00610
C      COMMON BLOCK FOR TERRAIN DESCRIPTION DATA                        VRT00620
C                                                                       VRT00630
C*****************************************************                  VRT00640
       COMMON /TERR/                                                    VRT00650
     X                 BEGHT,       @BEGINNING CONTOUR HEIGHT, USER UNITVRT00660
     X                 HTINCR,      @CONTOUR INCREMENT, USER UNITS      VRT00670
     X                 CONTUR(36,21)@DISTANCES FROM THE SOURCE ALONG EACVRT00680
     X                              @10-DEG RADIAL FOR HEIGHTS STARTING VRT00690
     X                              @AT BEGHT, IN INCREMENTS OF HTINCR--VRT00700
     X                              @UP TO 20 DISTANCES (CONTOUR INCREMEVRT00710
     X                              @ARE ALLOWED ALONG EACH RADIAL      VRT00720
C                                                                       VRT00730
C*****************************************************                  VRT00740
C                                                                       VRT00750
C      COMMON BLOCK FOR HOURLY METEOROLOGICAL DATA                      VRT00760
C                                                                       VRT00770
C*****************************************************                  VRT00780
       COMMON /MET/                                                     VRT00790
     X                 WDIR,        @ WIND DIRECTION                    VRT00800
     X                 WSPD,        @ WIND SPEED #1 (M/SEC)             VRT00810
     X                 DMX,         @ MIXING HEIGHT (M)                 VRT00820
     X                 IST,         @ STABILITY CLASS                   VRT00830
     X                 TEMP,        @ AMBIENT TEMPERATURE (DEG K)       VRT00840
     X                 XIY,         @ TURBULENCE, Y-COMPONENT           VRT00850
     X                 XIZ,         @ TURBULENCE, Z-COMPONENT           VRT00860
     X                 PRVPTG,      @ PLUME RISE VPTG                   VRT00870
     X                 HCVPTG,      @ HCRIT VPTG                        VRT00880
     X                 DTHETA,      @ HORIZONTAL WIND DIRECTION SHEAR   VRT00890
     X                 EPS,         @ WIND SPEED PROFILE EXPONENT       VRT00900
     X                 WSPD2        @ WIND SPEED #2 (M/SEC)             VRT00910
C                                                                       VRT00920
        COMMON /PR002/ VSCALE                                           VRT00930
        COMMON /PR009/ IPPP,PPVPTG                                      VRT00940
        COMMON /PR013/ TERCOR(6)                                        VRT00950
        COMMON /PR022/ IREFL                                            VRT00960
        COMMON /PR025/ IVERB                                            VRT00970
C                                                                       VRT00980
        REAL MCWI                                                       VRT00990
C                                                                       VRT01000
C       CORRECT PLUME HEIGHT FOR TERRAIN                                VRT01010
C                                                                       VRT01020
        IF(IPPP.EQ.1.AND.H.GT.DMX) H = DMX @ FOR PARTIAL PENETRATION    VRT01030
C                                                                       VRT01040
C       CALCULATE FROUDE # TO DETERMINE WHETHER PLUME FLOWS OVER TERRAINVRT01050
C       OR IMPINGES IN STABLE CONDITIONS.  IMPACTION DOES NOT OCCUR IN  VRT01060
C       NEUTRAL OR UNSTABLE CONDITIONS.                                 VRT01070
C                                                                       VRT01080
        IDIR = (INT(WDIR + 4.99))/10                                    VRT01090
        IF(IDIR.EQ.0) IDIR = 36                                         VRT01100
        INDEX = INT(CONTUR(IDIR,21))                                    VRT01110
C                                                                       VRT01120
        FROUDE = 1.0                                                    VRT01130
        HCRIT = 0.0                                                     VRT01140
```

```
      IF(IST.LE.4) GO TO 800
C
C     CALCULATE FROUDE # FOR STABLE CONDITIONS
C
      HILLTP = (BEGHT + (INDEX-1)*HTINCR) * VSCALE - BASEHT
      ESS = (9.806/TEMP) * HCVPTG
      IF(ESS.LE.0.0) GO TO 800
      FROUDE = UTOP/(HILLTP*SQRT(ESS))
      IF(FROUDE.GT.1.0) FROUDE = 1.0
      HCRIT = HILLTP * (1.0 - FROUDE)
      IF(H.GE.HCRIT) GO TO 800
      TERC = 0.0    @ POSSIBLE IMPINGEMENT
      GO TO 1000
  800 TERC = TERCOR(IST)
C
C     HPC IS THE PLUME HEIGHT ABOVE HCRIT; HTC IS THE TERRAIN HEIGHT
C     ABOVE HCRIT
C
 1000 HPC = H - HCRIT
      HTC = THT - HCRIT
      HPLUME = HPC*TERC    @  FOR TERRAIN ABOVE INITIAL PLUME HEIGHT
      IF(THT.LT.H) HPLUME = HPC - (1.0-TERC)*HTC
      IF(TERC.LT.0.00001.AND.H.LT.THT) HPLUME = H - THT @ NEGATIVE PLU
      IF(HTC.LT.0.0) HPLUME = H - THT  @  LEVEL PLUME, RECEP BELOW HC
C
C     HPLUME IS THE HEIGHT OF THE PLUME ABOVE THE RECEPTOR (ASSUMED TO
C     BE AT THE GROUND).
C
C     DETERMINE CONVENTIONAL VALUE OF VERTICAL DISTRIBUTION FUNCTION.
C     VDF INCORPORATES MULTIPLE REFLECTIONS AS DESCRIBED IN TURNER'S
C     WORKBOOK (1970), PAGE 36.
C
C     ADJUST MIXING HEIGHT FOR TERRAIN CORRECTION TO BE CONSISTENT WIT
C     PLUMES THAT CLEAR THE TERRAIN
C
      DMXC = (DMX-HCRIT)*TERC
      IF(THT.LT.DMX) DMXC = (DMX-HCRIT) - (1.0-TERC)*HTC
C
      CALL VDF(HPLUME,DMXC,SIGZ,V)
C
C     DETERMINE WHETHER DETAILED EXAMINATION OF MCWI CONCENTRATIONS
C     UPWIND OF THE RECEPTOR ARE NECESSARY.  IF SIGMA-Z *2.15 IS LESS
C     THAN THE PLUME HEIGHT ABOVE TERRAIN, REFLECTION EFFECTS ARE
C     NEGLIGIBLE.
C
      IF(IREFL.EQ.0.OR.HPLUME.GT.2.15*SIGZ) GO TO 5000
C
C     CONSIDER THE EFFECTS OF THE SECOND LAW OF THERMODYNAMICS.  FIND
C     A TERRAIN POINT UPWIND OF THE RECEPTOR WHERE SIGMA-Z * 2.15 IS
C     GREATER THAN HPLUME, THEN BACK UP ONE TERRAIN INCREMENT.
C
      IF(INDEX.LT.2) GO TO 5000
      X1 = 0.0
      DO 1500 I=1,INDEX
      TERRHT = (BEGHT + (I-1)*HTINCR) * VSCALE - BASEHT
      X2 = CONTUR(IDIR,I) * 1000.
      X = X2
```

```
C                                                                       VRT01673
C       IF PAST RECEPTOR POINT, CHECK HPL AND SZ AT RECEPTOR POINT      VRT01674
C                                                                       VRT01675
        IF(.NOT.(X2.GT.XP .AND. X1.LT.XP)) GO TO 1300                   VRT01676
        X = XP - 0.1                                                    VRT01677
        TERRHT = THT - 0.1                                              VRT01678
1300    CONTINUE                                                        VRT01679
        HPL = HPC * TERC                                                VRT01680
        HTC = TERRHT - HCRIT                                            VRT01682
        IF(TERRHT.LT.H) HPL = HPC - (1.0-TERC)*HTC                      VRT01684
        IF(TERC.LT.0.00001.AND.H.LT.TERRHT) HPL = H - TERRHT @ BELOW RECVRT01686
        IF(HTC.LT.0.0) HPL = H - TERRHT @  LEVEL PLUME, RECEP BELOW HC  VRT01688
C       IF(TERRHT.LT.H) HPL = HPC - (1.0-TERC)*(TERRHT-HCRIT)           VRT01690
C       IF(TERC.LT.0.00001.AND.H.LT.TERRHT) HPL = H - TERRHT @ NEGATIVE VRT01700
C       X = CONTUR(IDIR,I) * 1000.                                      VRT01710
        IF(HPL.LT.0.0) GO TO 5000  @ DO NOT CONSIDER POINTS ABOVE PLUME VRT01720
        IF(X.GE.XP.OR.TERRHT.GT.THT) GO TO 5000  @ NO MORE UPWIND POINTSVRT01730
C                                                                       VRT01740
C       COMPUTE SIGMA-Z                                                 VRT01750
C                                                                       VRT01760
        CALL SIGMAZ(IST,X,RISE,XIZ,SZ,SZA,SZB)                          VRT01770
        IF(HPL.LT.2.15*SZ) GO TO 1700   @ BEGIN REFLECTION CALCULATIONS VRT01780
        SIGZ1 = SZ   @ SAVE FOR REFLECTION CALCULATIONS                 VRT01790
        X1 = X2                                                         VRT01795
 1500   CONTINUE                                                        VRT01800
        GO TO 5000    @ NO UPWIND POINTS OF SIGNIFICANCE                 VRT01810
C                                                                       VRT01820
 1700   IF(I.EQ.1) GO TO 1750                                           VRT01830
        I = I - 1     @  BACK UP ONE TERRAIN INCREMENT                  VRT01840
        SZ = SIGZ1                                                      VRT01850
        GO TO 1800                                                      VRT01860
C                                                                       VRT01870
C       AT THIS POINT, PLUME HEIGHT IS AT LEAST 2 STANDARD DEVIATIONS   VRT01880
C       AWAY FROM THE SURFACE, AND TERRAIN REFLECTION EFFECTS ARE       VRT01890
C       NEGLIGIBLE.  DENOTE SIGMA-Z AT THIS POINT AS SIGZ1.  CALCULATE  VRT01900
C       MCWI HERE (NO TERRAIN EFFECTS) AND THEN INCREMENT THE HEIGHT    VRT01910
C       OF THE TERRAIN IN STEPS OF DELTAZ UNTIL THE ELEVATION OF THE    VRT01920
C       RECEPTOR POINT IS ATTAINED OR THE PLUME IMPINGES UPON TERRAIN.  VRT01930
C       DELTAZ IS THE MAXIMUM OF 0.2*SIGZ1 AND (THT-TERRHT)/10  .       VRT01940
C                                                                       VRT01950
 1750   SIGZ1 = SZ                                                      VRT01960
 1800   TERRHT = (BEGHT + (I-1) * HTINCR) * VSCALE - BASEHT             VRT01970
        HPL = HPC * TERC                                                VRT01980
        IF(TERRHT.LT.H) HPL = HPC - (1.0-TERC)*(TERRHT-HCRIT)           VRT01990
        IF(TERC.LT.0.00001.AND.H.LT.TERRHT) HPL = H - TERRHT @ NEGATIVE VRT02000
        DMXC = (DMX-HCRIT)*TERC                                         VRT02010
        IF(TERRHT.LT.DMX) DMXC = (DMX-HCRIT) - (1.0-TERC)*(TERRHT-HCRIT)VRT02020
        X = CONTUR(IDIR,I) * 1000.                                      VRT02030
        DELTAZ = AMAX1(SIGZ1/5.0,(THT-TERRHT)/10.+0.1)                  VRT02040
C                                                                       VRT02050
C       THE NEXT LOOP DETERMINES THE MCWI AT A FIXED DOWNWIND DISTANCE BVRT02060
C       CALCULATING THE CWI VALUE AT SEVERAL POINTS IN THE HEIGHT INTERVVRT02070
C       BETWEEN THE PLUME LEVEL AND THE GROUND.  THIS HEIGHT INTERVAL ISVRT02080
C       DIVIDED INTO 5 EQUAL SECTIONS, AND THE CWI IS EVALUATED AT EACH VRT02090
C       INTERVAL BETWEEN PLUME CENTERLINE AND THE GROUND, A POSSIBLE TOTVRT02100
C       OF 6 POINTS.  IN FLAT TERRAIN, THE MAXIMUM CWI OCCURS AT OR NEARVRT02110
C       THE PLUME CENTERLINE, AND MOVES CLOSER TO THE GROUND SURFACE AS VRT02120
```

```
C       THE TERRAIN RISES TO MEET THE PLUME.  IN THE LOOP BELOW, THE CWI
C       IS FIRST EVALUATED AT PLUME HEIGHT, THEN AT SUCCESSIVE HEIGHTS
C       BELOW IT.  IF THE CWI DECREASES FROM THE VALUE AT THE HEIGHT
C       ABOVE IT, THE SEARCH FOR THE MAXIMUM CWI STOPS.
C
        IFINAL = 0    @  SET TO 1 IF MCWI AT RECEPTOR POINT IS EVALUATED
        K = 0
        INIT = 1  @   START LOOKING AT CWI AT THIS HEIGHT
 2000   MCWI = 0.0
        DO 2500 J = INIT,6
        Z = HPL * (6-J)/5.
        CALL VDF(HPL-Z,DMXC-Z,SZ,V1)
        CALL VDF(HPL+Z,DMXC+Z,SZ,V2)
        CWI = (V1 + V2)/2.0
        IF(CWI.LE.MCWI) GO TO 2600    @ HAVE FOUND MCWI AT THIS X
        MCWI = CWI
        ZOLD = Z
 2500   CONTINUE
 2600   INIT = MIN(J-2,6)  @ RESET INIT
        IF(INIT.LT.1) INIT = 1
        IF(K.EQ.0) GO TO 2800
        IF(CWIMIN.LT.MCWI) GO TO 2900
 2800   CWIMIN = MCWI    @ KEEP TRACK OF MINIMUM MCWI
        XMAX = X
        ZMAX = ZOLD
        R = MCWI * 2.506628 * SZ
C
C       INCREMENT TERRAIN HEIGHT BY SIGZ1/5 AND FIND ASSOCIATED
C       DOWNWIND DISTANCE
C
 2900   IF(IFINAL.EQ.1) GO TO 4000    @ FINISHED
        TERRHT = TERRHT + DELTAZ    @  INCREMENT TERRAIN
        IF(TERRHT.GT.THT) GO TO 3000    @ EVALUATE MCWI AT RECEPTOR, THE
        CALL DOWNWD(IDIR,TERRHT,INDEX,BASEHT,X)
        IF(X.GT.999998. .OR. X.GT.XP) GO TO 3000   @ CHECK RECEPTOR MCWI
C
C       COMPUTE SIGMA-Z AT NEW LOCATION
C
        CALL SIGMAZ(IST,X,RISE,XIZ,SZ,SZA,SZB)
        HPL = HPC * TERC
        IF(TERRHT.LT.H) HPL = HPC - (1.0-TERC)*(TERRHT-HCRIT)
        IF(TERC.LT.0.00001.AND.H.LT.TERRHT) HPL = H - TERRHT @ NEGATIVE
        DMXC = (DMX-HCRIT)*TERC
        IF(TERRHT.LT.DMX) DMXC = (DMX-HCRIT) - (1.0-TERC)*(TERRHT-HCRIT)
        IF(HPL.LT.0.001) GO TO 3000 @ CHECK MCWI AT RECEPTOR POINT
        K = K + 1
        GO TO 2000
C
 3000   HPL = HPLUME     @ EVALUATE MCWI AT RECEPTOR POINT
        IF(HPL.LT.0.0) GO TO 4000
        SZ = SIGZ
        X = XP
        TERRHT = THT
        IFINAL = 1
        GO TO 2000
C
C       END MCWI LOOP
```

```
C
 4000   RVDF = R/(2.506628 * SIGZ)
        RETURN
C
C       IF NO REFLECTION FOUND, SET R TO 1.00.
C       IF NO RELECTION CONSIDERED, SET CWIMIN TO V IF R>=1,
C           ELSE SET R TO 1 AND COMPUTE CWIMIN
C
 5000   IF(IREFL.EQ.0) GO TO 6000
C
 5500   R = 1.00
        RVDF = R/(2.506628*SIGZ)
        CWIMIN = 1.0/(2.506628 * SIGZ)
        RETURN
C
 6000   RVDF = V
        R = RVDF * 2.506628 * SIGZ
        IF(R.LT.1.0) GO TO 5500   @ SET R TO AT LEAST 1.0
        RETURN
C
        END
        SUBROUTINE DOWNWD(IDIR,TERRHT,INDEX,BASEHT,X)
C
C*********************************************************************
C
C       THIS ROUTINE DETERMINES THE DOWNWIND DISTANCE ASSOCIATED WITH A
C       GIVEN TERRAIN HEIGHT WITH THE USER-SUPPLIED TERRAIN INFORMATION
C
C       IDIR    - WIND DIRECTION (ROUNDED TO NEAREST 10 DEG, DIVIDED BY
C       TERRHT  - INPUT TERRAIN HEIGHT (M) FOR WHICH A DOWNWIND DISTANCE
C                 IS DESIRED.
C       INDEX   - THE MAXIMUM NUMBER OF DISTANCE-TERRAIN HT PAIRS KNOWN
C                  FOR THIS WIND DIRECTION
C       BASEHT  - BASE HT OF THE STACK, A REFERENCE LEVEL FROM WHICH ALL
C                 HEIGHTS ARE COMPUTED.
C       X       - THE RETURNED DOWNWIND DISTANCE  (METERS)
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C*********************************************************************
C
C*****************************************************************
C
C      COMMON BLOCK FOR TERRAIN DESCRIPTION DATA
C
C*****************************************************************
       COMMON /TERR/
     X                BEGHT,       @BEGINNING CONTOUR HT, USER UNITS
     X                HTINCR,      @CONTOUR INCREMENT, USER UNITS
     X                CONTUR(36,21)@DISTANCES FROM SOURCE ALONG EACH
     X                             @10-DEG RADIAL FOR HEIGHTS STARTING
     X                             @AT BEGHT, IN INCREMENTS OF HTINCR--
     X                             @UP TO 20 DISTANCES (CONTOUR INCRE-
     X                             @MENTS) ALLOWED ALONG EACH RADIAL
C
        COMMON /PR002/ VSCALE
C
        DO 1000  I = 1,INDEX
C
        HT = (BEGHT + (I-1)*HTINCR) * VSCALE - BASEHT
        IF(I.EQ.1.OR.TERRHT.GT.HT) GO TO 500  @ KEEP SEARCHING
        X2 = CONTUR(IDIR,I) * 1000.
C
C       TERRAIN HT IS BETWEEN THIS LEVEL AND THE PREVIOUS ONE
C
  200   FRAC = (TERRHT - OLDHT)/(HTINCR*VSCALE)
        X = X1 + (X2-X1) * FRAC
        RETURN
C
  500   X1 = CONTUR(IDIR,I) * 1000.
        OLDHT = HT
        IF(I.LT.INDEX) GO TO 1000
C
C       IF ABOVE THE LAST CONTOUR, POSITION AN IMAGINARY TERRAIN CONTOUR
C       ABOVE THE TOP OF THE HILL, RETAINING THE SAME SLOPE AS THAT IN
C       THE LAST REAL CONTOUR INTERVAL.  THEN, COMPUTE THE DOWNWIND
```

```
C       DISTANCE THE USUAL WAY.                                         DWN00580
C                                                                       DWN00590
        X2 = X1 + (X1-CONTUR([illegible]R,INDEX-1)*1000.)                DWN00600
        GO TO 200                                                       DWN00610
C                                                                       DWN00620
 1000   CONTINUE                                                        DWN00630
        END                                                             DWN00640
```

```
      SUBROUTINE VDF(HH,D,S,V)
C
C**********************************************************************
C
C       THIS SUBROUTINE CALCULATES THE VERTICAL DISTRIBUTION:
C       MULTIPLY RELECTED GAUSSIAN AS PER ERT MEMO CS 093
C
C       HH      -RELEASE HEIGHT (M)
C       D       -MIXING LID (M)
C       S       -VERTICAL DISPERSION COEFFICIENT (SIGMA Z)
C       V       -CALCULATED DISTRIBUTION VALUE (1/M)
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C**********************************************************************
C
C  ACCURACY PARAMETERS
C
      TMIN=0.0512
      TMAX=9.21
      V=1
      T=(S/D)**2
      H=HH/D
C
      IF(T.GE. .6) GO TO 500
C
      ARG=2.*(1.-H)/T
C
      IF (ARG.GE.TMAX) GO TO 400
      IF (ARG.LT.TMIN) V=V+1.-ARG
      IF (ARG.GE.TMIN) V=V+EXP(-ARG)
C
      ARG=2.*(1.+H)/T
C
      IF(ARG.GE.TMAX) GO TO 400
      V=V+EXP(-ARG)
C
      ARG=4.*(2-H)/T
C
      IF(ARG.GE. TMAX) GO TO 400
      V=V+EXP(-ARG)
C
      ARG=4.*(2+H)/T
C
      IF(ARG.LT.TMAX) V=V+EXP(-ARG)
C
  400 ARG=-.5*H**2/T
      IF (ARG.LT.-90.) V=0.
      IF(ARG.GE.-90.) V=.797885*V*EXP(ARG)/S  @.797885=ROOT 2/PI
C
     IF (V.LT.1E-30) V=0.    @TO PREVENT UNDERFLOWS
C
      RETURN
C
  500 ARG=4.934802*T                     @4.934802=PI**2/2
```

```
C
      IF (ARG.GE.TMAX) GO TO 900
      V=V+2.*EXP(-ARG)*COS(3.141593*H)
C
      ARG=19.739209*T                  @19.739209=2*PI**2
C
      IF (ARG.LT.TMAX) V=V+2.*EXP(-ARG)*COS(6.283185*H)
C
  900 V=V/D
C
     IF (V.LT.1E-30) V=0.    @TO PREVENT UNDERFLOWS
C
      RETURN
C
      END
```

```
        SUBROUTINE WRCONC(CONC,NR)
C
C*********************************************************************
C
C       THIS ROUTINE WRITES ONE CONCENTRATION FILE RECORD, WHICH HAS UP
C       TO 400 RECEPTOR CONCENTRATIONS.
C
C       CONC    ARRAY OF SIZE NREC TO RECEIVE CONCENTRATION VALUES
C       NR      # OF CONCENTRATIONS TO BE WRITTEN FOR EACH RECORD
C
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C
C       RTDM
C
C*********************************************************************
C
C******************************************************
C
C      COMMON BLOCK FOR HOURLY METEOROLOGICAL DATA
C
C******************************************************
       COMMON /MET/
     X                 WDIR,         @ WIND DIRECTION
     X                 WSPD,         @ WIND SPEED (M/SEC)
     X                 DMX,          @ MIXING HEIGHT (M)
     X                 IST,          @ STABILITY CLASS
     X                 TEMP,         @ AMBIENT TEMPERATURE (DEG K)
     X                 XIY,          @ TURBULENCE, Y-COMPONENT
     X                 XIZ,          @ TURBULENCE, Z-COMPONENT
     X                 PRVPTG,       @ PLUME RISE VPTG
     X                 HCVPTG,       @ HCRIT VPTG
     X                 DTHETA,       @ HORIZONTAL WIND DIRECTION SHEAR
     X                 EPS           @ WIND SPEED PROFILE EXPONENT
C
        DIMENSION CONC(NR)
        INTEGER MET(4)
C
        MET(1) = INT(DMX + 0.5)
        MET(2) = INT(WDIR + 0.5)
        MET(3) = IST
        MET(4) = INT(WSPD + 0.5)
        WRITE(9) MET,CONC
        RETURN
        END
```

```
C
      SUBROUTINE PAGE
C
C**********************************************************************
C
C       THIS ROUTINE SKIPS TO A NEW PAGE AND WRITES A PAGE HEADER
C
C       ERT, INC.
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       RTDM
C
C**********************************************************************
C
      COMMON /HEAD/ NPAGE,NLINE
      NPAGE=NPAGE+1
      NLINE=3
      WRITE(6,1000) NPAGE
 1000 FORMAT('1','  ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   ',
     X 'LEVEL 861130',28X,'PAGE',1X,I3,/)
      RETURN
      END
      SUBROUTINE LINES(N,IVAL)
C
C***********************************************************************
C
C      N       NUMBER OF NEW LINES
C      IVAL    DETERMINES WHETHER OR NOT A NEW PAGE IS STARTED
C
C     ERT, INC.
C     696 VIRGINIA ROAD, CONCORD, MASS. 01742
C
C     RTDM
C
C***********************************************************************
C
      COMMON /HEAD/ NPAGE,NLINE
      IVAL = 0
      NLINE = NLINE + N
      IF(NLINE.LE.63) RETURN
      CALL PAGE
      NLINE = NLINE + N
      IVAL = 1
      RETURN
      END
```

APPENDIX C

SOURCE CODE LISTINGS FOR ANALYSIS

```
C********************************************************************
C
C       MAIN PROGRAM FOR ANALYSIS
C
C       ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       ANALYSIS  VERSION 2.30    LEVEL 851125
C
C********************************************************************
C
        COMMON /HEAD/NPAGE,NLINE
        REAL KEYS(5),NINES,ENDJ
        DATA KEYS /'CUMF','AVER','TOPV','PEAK','SEQA'/
        DATA NINES/'9999'/,ENDJ/'ENDJ'/
C
        NPAGE = 0
        NLINE = 0
        CALL PAGE
   30   READ(5,1,END=9000)WORD
        REWIND 8
    1   FORMAT(A4)
        IF(WORD.EQ.NINES)GO TO 30
        IF(WORD.EQ.ENDJ)GO TO 9000
        DO 50 I=1,5
        IF(WORD.EQ.KEYS(I))GO TO 70
   50   CONTINUE
        WRITE(6,2) WORD
    2   FORMAT(/,'   KEYWORD NOT AMONG THOSE EXPECTED: ',A4)
        GO TO 9000
   70   K=I
C
       GO TO (100,200,300,400,500), K
C
  100 CALL CUMFRQ
      GO TO 30
C
  200 CALL AVERGE
      GO TO 30
C
  300 CALL TOPVAL
      GO TO 30
C
  400 CALL PEAK
      GO TO 30
C
  500 CALL SEQADD
      GO TO 30
C
 9000   CONTINUE
        STOP
        END
      SUBROUTINE PEAK
C*********************************************************************
C
C       THIS SUBROUTINE IS USED TO IDENTIFY NON-OVERLAPPING
C       N-HOUR AVERAGES THAT EXCEED A USER-SPECIFIED THRESHOLD
C
C       ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       ANALYSIS  VERSION 2.30    LEVEL 851125
C
C*********************************************************************
C
      LOGICAL LPRINT,EOF1
      DIMENSION UNITS(2),NN(400),AIR(4),MET(4,24),
     1DAY(400),HOURS(400),CONC(400),TOTAL(23,400),
     2CMAX(400),METNME(4)
      INTEGER AIR,DAY,HOURS
      REAL JUNK,METNME
      DATA METNME /'MIX ','DIR ','STAB','SPD '/
      DATA JUNK /'    '/
      IPUT = 6
      IC = 5
      ICH = 8
      X1 = '----'
      X2 = '+   '
      X3 = '!   '
C
        WRITE(IPUT,45)
   45   FORMAT(///,'   PEAK',///)
C
      WRITE(IPUT,1)
    1 FORMAT(//,12X,'NHR',7X,'THR',5X,'HOURIN',4X,'DAYSIN',7X,'NH',/)
      READ(IC,2,ERR=8000)NHR,THR,HOURIN,DAYSIN,NH
    2 FORMAT(10X,I5,3F10.0,I10)
      IF(NHR.LT.0)NHR=1
      IF(NH.LT.1) NH = 1
      WRITE(IPUT,2) NHR,THR,HOURIN,DAYSIN,NH
      WRITE(IPUT,3)
    3 FORMAT(///,13X,'RFACT',3X,'UNITS',8X,'LPRINT',3X,'NR  SCALE',/)
      READ(IC,4,ERR=8000)RFACT,UNITS,LPRINT,NR,SCALE
    4 FORMAT(10X,F10.0,2A4,2X,L10,I5,F10.0)
      IF(RFACT.LE.0.) RFACT=1.0E+6
      IF(SCALE.EQ.0.0) SCALE = 1.0
      IF(UNITS(1).EQ.JUNK.AND.UNITS(2).EQ.JUNK) LPRINT=.TRUE.
      WRITE(IPUT,4) RFACT,UNITS,LPRINT,NR,SCALE
      IF(NR.GE.1.AND.NR.LE.400) GO TO 500
      WRITE(IPUT,5) NR
    5 FORMAT(2X,'# OF RECEPTORS SPECIFIED IS OUT OF RANGE (1-400): ',I5)
      GO TO 9000
  500 IF(NHR.GE.1.AND.NHR.LE.24) GO TO 700
      WRITE(IPUT,6) NHR
    6 FORMAT(2X,'NHR IS OUT OF RANGE (1-24): ',I4)
      GO TO 9000
  700 IF(THR.GE.0.)GO TO 800
      WRITE(IPUT,8) THR
    8 FORMAT(2X,'THR IS OUT OF BOUNDS ( >0 ): ',E11.4)
```

```
      GO TO 9000                                            PEK00058
  800 SCALE = SCALE*RFACT                                   PEK00059
      IF(UNITS(1).NE.JUNK) GO TO 1100                       PEK00060
      UNITS(1)='uG/M'                                       PEK00061
      UNITS(2)='**3 '                                       PEK00062
 1100 CONTINUE                                              PEK00063
      HOURIN=HOURIN+24.*DAYSIN                              PEK00064
      HOUR=0                                                PEK00065
      MM=0                                                  PEK00066
      ALL=0                                                 PEK00067
      ICNT = 0                                              PEK00068
      IF(HOURIN.LE.0.) ALL=1                                PEK00069
      DO 1500 I = 1,400                                     PEK00070
      CMAX(I) = 0.0                                         PEK00071
      DAY(I) = 0.0                                          PEK00072
      HOURS(I) = 0                                          PEK00073
      NN(I) = 0                                             PEK00074
 1500 CONTINUE                                              PEK00075
      XHR = FLOAT(NHR)                                      PEK00076
      CALL PAGE                                             PEK00077
C                                                           PEK00078
C     START READ LOOP                                       PEK00079
C                                                           PEK00080
 1550 IF(ALL.NE.1..AND.HOUR.GE.HOURIN) GO TO 4000           PEK00081
      DO 2500 I=1,NHR                                       PEK00082
      IF(ICNT.EQ.1)GO TO 2200                               PEK00083
      CALL READIT(AIR,CONC,NR,ICH,EOF1)                     PEK00084
      IF(EOF1) GO TO 8100                                   PEK00085
      ICNT=1                                                PEK00086
      GO TO 2250                                            PEK00087
 2200 CALL READIT(AIR,CONC,NR,ICH,EOF1)                     PEK00088
      IF(EOF1) GO TO 4000                                   PEK00089
 2250 DO 2300 L=1,4                                         PEK00090
      MET(L,I)=AIR(L)                                       PEK00091
 2300 CONTINUE                                              PEK00092
      DO 2350 K=1,NR                                        PEK00093
      CONC(K)=CONC(K)*SCALE                                 PEK00094
      IF(I.LT.NHR) TOTAL(I,K)=CONC(K)                       PEK00095
 2350 CONTINUE                                              PEK00096
 2500 CONTINUE                                              PEK00097
C                                                           PEK00098
      MM=MM+1                                               PEK00099
      HOUR=HOUR+FLOAT(NHR*NH)                               PEK00100
      DO 3800 K=1,NR                                        PEK00101
      AVR = 0.0                                             PEK00102
      DO 2700 I = 1,NHR-1                                   PEK00103
 2700 AVR = AVR + TOTAL(I,K)/XHR                            PEK00104
      AVR = AVR + CONC(K)/XHR                               PEK00105
      IF(AVR.LE.CMAX(K)) GO TO 3000                         PEK00106
      CMAX(K)=AVR                                           PEK00107
      DAY(K)=INT((HOUR-1.)/24.)+1.                          PEK00108
      HOURS(K)=AMOD(HOUR-1.,24.)+1                          PEK00109
 3000 CONTINUE                                              PEK00110
      IF(AVR.LT.THR) GO TO 3800                             PEK00111
      NN(K)=NN(K)+1                                         PEK00112
      IDAY=INT((HOUR-1.)/24.)+1                             PEK00113
      IHOUR=AMOD(HOUR-1.,24.)+1.                            PEK00114
      CALL LINES(3)
      IF(LPRINT) CALL LINES(NHR+2)
      WRITE(IPUT,11)THR,UNITS,IDAY,IHOUR,K
   11 FORMAT(/,2X,F10.4,1X,2A4,' EXCEEDED AT DAY ',I4,' HOUR ',I2,2X,
     X'AT RECEPTOR ',I3)
      IF(.NOT.(LPRINT))GO TO 3700
      WRITE(IPUT,12)UNITS
   12 FORMAT('  ****',1X,'CONCENTRATIONS (',2A4,') ',7X,'WEATHER')
      WRITE(IPUT,41) METNME
   41 FORMAT('  RECORD',7X,'TOTAL',14X,4(A4,1X))
      DO 3600 I=1,NHR-1
      WRITE(IPUT,17)I,TOTAL(I,K),(MET(L,I),L=1,4)
   17 FORMAT(5X,I2,4X,F10.4,11X,4I5)
 3600 CONTINUE
      WRITE(IPUT,17) NHR,CONC(K),(MET(L,NHR),L=1,4)
 3700 WRITE(IPUT,16) AVR
   16 FORMAT('  MEAN ',4X,F10.4)
 3800 CONTINUE
      GO TO 1550
C
 4000 CALL PAGE
      WRITE(IPUT,19)UNITS,MM,NHR
   19 FORMAT(/,' TOTAL MAXIMUM CONCENTRATIONS (',2A4,') FOR ',I5,' (',
     X I2,'-HOUR) AVERAGING PERIOD(S)',/)
      CALL LINES(3)
      DO 5000 LSTART = 1,NR,8
      CALL LINES(5)
      LEND = MIN0(LSTART+7,NR)
      WRITE(IPUT,21)(L,L=LSTART,LEND)
   21 FORMAT('  RECEP +',8(2X,I3,3X,'+'))
      WRITE(IPUT,22) (X1,X1,X2,L=LSTART,LEND)
   22 FORMAT(' -------+',8(2A4,A1))
      WRITE(IPUT,23) (CMAX(K),K=LSTART,LEND)
   23 FORMAT('   CONC !',8(F8.3,'!'))
      WRITE(IPUT,24)(DAY(K),HOURS(K),K=LSTART,LEND)
   24 FORMAT(' DAY/HR !',8(I4,2X,I2,'!'),/)
 5000 CONTINUE
C
      CALL PAGE
      MMNHR=MM*NHR
      WRITE(IPUT,27)NHR,THR,UNITS,MMNHR,(X1,X1,X2,K=1,MIN0(8,NR))
   27 FORMAT(/,7X,'NUMBER OF ',I2,'-HOUR AVERAGES ABOVE ',F10.4,1X,2A4,
     X ' FOR ',I5,' HOURS',//,' RECEPTORS:',/,' -------+',8(2A4,A1))
      CALL LINES(5)
      DO 7000 N=1,NR,8
      CALL LINES(2)
      M=MIN0(N+7,NR)
      WRITE(IPUT,28)N,M,(NN(K),K=N,M)
   28 FORMAT(1X,I3,'-',I3,'!',8(3X,I3,2X,'!'))
      WRITE(IPUT,26) (X1,X1,X3,K=N,M)
   26 FORMAT(' -------!',8(2A4,A1))
 7000 CONTINUE
      CALL PAGE
      RETURN
C
 8000 WRITE(IPUT,29)
   29 FORMAT(2X,'ILLEGAL DATA LINE.')
```

```
      GO TO 9000                                                        PEK00172
 8100 WRITE(IPUT,30)                                                    PEK00173
   30 FORMAT(2X,'UNEXPECTED END OF FILE.')                              PEK00174
C                                                                       PEK00175
 9000 STOP                                                              PEK00176
      END                                                               PEK00177
      SUBROUTINE TOPVAL
C
C***********************************************************************
C
C       THIS SUBROUTINE DISPLAYS THE HIGHEST N CONCENTRATIONS
C       (USER-SPECIFIED N) MODELED AT EACH RECEPTOR.
C
C       ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       ANALYSIS  VERSION 2.30    LEVEL 851125
C
C***********************************************************************
C
       DIMENSION VALUE(2501),AVR(400),DAY(2501),HOURS(2501),MET(4),
     X CONC(400),JX(2501),T1(400),T2(400),T1REC(25),T2REC(25),T3(25),
     X T4(25)
      INTEGER ALL,DAY,HOURS,T1REC,T2REC
      INTEGER MET
      LOGICAL EOF1
      IC = 5
      ICH=8
      IPUT=6
      ICNT=0
      X1 = '----'
      X2 = '---+'
C
      WRITE(IPUT,45)
   45 FORMAT(///,'   TOPVAL',///)
C
      WRITE(IPUT,1)
    1 FORMAT(//,13X,'LP',3X,'NH',3X,'NM',4X,'DAYSIN',4X,
     X 'HOURIN',/)
      READ(IC,2,ERR=8000)LP,NH,NM,DAYSIN,HOURIN
    2 FORMAT(10X,3I5,2F10.0)
      READ(IC,4,ERR=8000)NR,RFACT
    4 FORMAT(10X,I10,F10.0)
      IF(LP.LE.0) LP=1
      IF(NH.LT.1) NH = 1
      WRITE(IPUT,2) LP,NH,NM,DAYSIN,HOURIN
      WRITE(IPUT,3)
    3 FORMAT(///,18X,'NR',3X,'RFACT',/)
      WRITE(IPUT,4) NR,RFACT
      IF(NR.GE.1.AND.NR.LE.400) GO TO 1000
      WRITE(IPUT,5) NR
    5 FORMAT(/,'  NR OUT OF RANGE (1-400): ',I5)
      GO TO 9000
 1000 IF(NM.GE.1.AND.NM.LE.2500/NR) GO TO 1100
      WRITE(IPUT,6)NM,NR
    6 FORMAT(/,'    NM*NR OUT OF RANGE ( <=2500): NM = ',I5,
     X ', NR = ',I5)
      GO TO 9000
 1100 HOURIN=HOURIN+24.*DAYSIN
      IF(NM.EQ.1) NM = 2
      ALL=0
      IF(HOURIN.LE.0.) ALL=1.
      IF (RFACT.LE.0.) RFACT=1.0E+6
      HOUR=0.
      DO 1200 I = 1,2501
      VALUE(I) = 0.0
      DAY(I) = 0
 1200 HOURS(I) = 0
 1500 IF(ALL.NE.1.AND.HOUR.GE.HOURIN) GO TO 4000
      DO 1600 IR=1,NR
      AVR(IR)=0.
 1600 CONTINUE
      DO 2100 J=1,LP
      IF(ICNT.EQ.1) GO TO 1800
      CALL READIT(MET,CONC,NR,ICH,EOF1)
      IF(EOF1) GO TO 8500
      ICNT=1
      GO TO 1900
 1800 CALL READIT(MET,CONC,NR,ICH,EOF1)
      IF(EOF1) GO TO 4000
 1900 DO 2000 IR=1,NR
      AVR(IR)=AVR(IR)+CONC(IR)
 2000 CONTINUE
 2100 CONTINUE
      HOUR=HOUR+FLOAT(LP*NH)
      DO 3000 IR=1,NR
      AVR(IR)=AVR(IR)/FLOAT(LP)
      K=(IR-1)*NM
      IM=NM
 2200 KIM=K+IM
      KIM1=KIM -1
      IF(AVR(IR).LE.VALUE(KIM)) GO TO 2500
      IF(IM.EQ.1) GO TO 2450
      VALUE(KIM)=VALUE(KIM1)
      DAY(KIM)=DAY(KIM1)
      HOURS(KIM)=HOURS(KIM1)
      IM=IM-1
      GO TO 2200
 2450 IM = 0
 2500 IF(IM.GE.NM) GO TO 3000
      KIMP1=K+IM+1
      VALUE(KIMP1)=AVR(IR)
      DAY(KIMP1)=(HOUR-1.)/24.+1.
      HOURS(KIMP1)=AMOD(HOUR-1.,24.)+1.
 3000 CONTINUE
      GO TO 1500
C
C       ALL DATA READ IN
C
C       GET TOP 25 HIGHEST AND SECOND-HIGHEST VALUES
C
 4000 DO 4100 I = 1,NR
      T1(I) = VALUE((I-1)*NM + 1) * RFACT
      T2(I) = VALUE((I-1)*NM + 2) * RFACT
 4100 CONTINUE
      DO 4150 I = 1,25
      T1REC(I) = I
      T2REC(I) = I
      T3(I) = 0.0
      T4(I) = 0.0
 4150 CONTINUE
      NLIM = MIN0(25,NR)
      DO 4300 J = 1,NLIM
      DO 4250 I = 1,NR
      IF(T1(I).LE.T3(J)) GO TO 4200
      T3(J) = T1(I)
      T1REC(J) = I
 4200 CONTINUE
      IF(T2(I).LE.T4(J)) GO TO 4250
      T4(J) = T2(I)
      T2REC(J) = I
 4250 CONTINUE
      T1(T1REC(J)) = 0.0
      T2(T2REC(J)) = 0.0
 4300 CONTINUE
      DO 4400 I=1,2500
      VALUE(I)=VALUE(I)*RFACT
 4400 CONTINUE
      DO 6000 ISTART=1,NR,16
      IEND=MIN0(ISTART+15,NR)
      DO 5500 LSTART=1,NM,5
      LEND=MIN0(LSTART+4,NM)
      CALL PAGE
      DO 4500 IM=LSTART,LEND
      JX(IM)=IM
 4500 CONTINUE
      WRITE(IPUT,10)NM,LP,HOUR
   10 FORMAT(/,7X,'TOP ',I3,' CONCENTRATIONS OF ',I2,'-HOUR AVERAGES ',
     X'FOR ',F6.0,' HOURS')
      WRITE(IPUT,11) (JX(IL),IL=LSTART,LEND)
   11 FORMAT(/,4X,'RECEPTOR   I',5(3X,'TOP ',I3,' I'))
      WRITE(IPUT,12) (X1,X1,X2,IL = LSTART,LEND+1)
   12 FORMAT(4X,6(3A4))
      DO 5000 IR=ISTART,IEND
      K=(IR-1)*NM
      LST1=LSTART+K
      LND1=LEND+K
      WRITE(IPUT,13)IR,(VALUE(KX),KX=LST1,LND1)
   13 FORMAT(6X,I3,6X,'I',5(F10.4,' I'))
      WRITE(IPUT,14)(DAY(KIL),HOURS(KIL),KIL=LST1,LND1)
   14 FORMAT(4X,'DAY/HOUR',3X,'I',5(2I5,' I'))
      WRITE(IPUT,12) (X1,X1,X2,IL = LSTART,LEND+1)
 5000 CONTINUE
 5500 CONTINUE
 6000 CONTINUE
C
      CALL PAGE
      WRITE(IPUT,15) NLIM
   15 FORMAT(/,36X,'TOP ',I2,' HIGHEST AND SECOND-'
     X 'HIGHEST CONCENTRATIONS',//)
      WRITE(IPUT,16)
   16 FORMAT(43X,'HIGHEST',22X,'SECOND-HIGHEST',//,
     X 27X,'RANK',5X,'RECEPTOR   CONCENTRATION',8X,
     X 'RECEPTOR   CONCENTRATION',//)
      WRITE(IPUT,17) (J,T1REC(J),T3(J),T2REC(J),T4(J),J=1,NLIM)
   17 FORMAT(28X,I2,9X,I3,7X,F10.3,12X,I3,7X,F10.3,/)
      CALL PAGE
      RETURN                                                            TOP00172
C                                                                       TOP00173
 8000 WRITE(IPUT,21)                                                    TOP00174
   21 FORMAT(/,'   ILLEGAL DATA LINE.')                                 TOP00175
      GO TO 9000                                                        TOP00176
 8500 WRITE(IPUT,22)                                                    TOP00177
   22 FORMAT(/,'   UNEXPECTED END OF CONCENTRATION FILE.')              TOP00178
 9000 STOP                                                              TOP00179
      END                                                               TOP00180
      SUBROUTINE CUMFRQ
C
C*********************************************************************
C
C        THIS ROUTINE IS USED TO COMPUTE CUMULATIVE FREQUENCY
C        DISTRIBUTIONS AND AVERAGE CONCENTRATIONS FOR UP TO
C        400 RECEPTORS.
C
C        ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C        696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C        ANALYSIS  VERSION 2.30    LEVEL 851125
C
C*********************************************************************
C
      DIMENSION LEV(20),FREQ(22)
      DIMENSION MET(4),CONC(400),FCAT(22,400),VAL(400),VIOL(400)
      REAL LEV
      INTEGER ALL
      INTEGER MET
      LOGICAL EOF1
      IC = 5
      ICH=8
      IPUT=6
      ICNT=0
      X1 = '----'
      X2 = '---+'
C
      WRITE(IPUT,45)
   45 FORMAT(///,'   CUMFREQ',///)
C
      WRITE(IPUT,1)
    1 FORMAT(/,9X,'HOURIN',4X,'DAYSIN',4X,'RFACT',8X,
     X 'NHR',2X,'NLEV  NR')
      READ(IC,2,ERR=8000)HOURIN,DAYSIN,RFACT,NHR,NLEV,NR
    2 FORMAT(30X,3F10.0,I10,2I5)
    3 FORMAT(/,5X,3F10.0,I10,2I5)
      ALL=1
      IF(HOURIN.GT.0.0.OR.DAYSIN.GT.0.0) ALL=0
      IF(RFACT.LE.0. ) RFACT=1.0E+06
      IF(NHR.LE.0) NHR=1
      WRITE(6,3) HOURIN,DAYSIN,RFACT,NHR,NLEV,NR
      IF(NLEV.GE.0.AND.NLEV.LE.20) GO TO 1000
      WRITE(IPUT,4)
    4 FORMAT(/,'   NLEV OUT OF RANGE (1-20).')
      GO TO 9000
 1000 IF(NR.GE.1.AND.NR.LE.400) GO TO 1100
      WRITE(IPUT,5)
    5 FORMAT(/,'   NR OUT OF RANGE (1-400).')
      GO TO 9000
 1100 READ(IC,6)(LEV(II),II=1,NLEV)
    6 FORMAT(10X,6F10.1,10X)
      MLEV=NLEV+2
      WRITE(IPUT,50)
   50 FORMAT(///,'     CUMULATIVE LEVELS:',/)
      WRITE(IPUT,6) (LEV(II),II=1,NLEV)
      LEV(NLEV+1) = 9.0E20
      HOUR=0.
      DO 1300 I = 1,400
      DO 1200 J = 1,MLEV
 1200 FCAT(J,I) = 0.0
 1300 VIOL(I) = 0.0
      HOURIN=HOURIN+24.*DAYSIN
      XHR = FLOAT(NHR)
C
C     DATA READ LOOP
C
 1500 IF(ALL.NE.1.AND.HOUR.GE.HOURIN) GO TO 3000
      DO 1700 I = 1,NR
 1700 VAL(I) = 0.0
      DO 2500 IHR=1,NHR
      IF(ICNT.EQ.1) GO TO 2200
      CALL READIT(MET,CONC,NR,ICH,EOF1)
      IF(EOF1) GO TO 3000
      ICNT=1
      GO TO 2300
 2200 CALL READIT(MET,CONC,NR,ICH,EOF1)
      IF(EOF1) GO TO 3000
 2300 DO 2400 I=1,NR
      VAL(I) = VAL(I) + RFACT*CONC(I)/XHR
 2400 CONTINUE
 2500 CONTINUE
      HOUR=HOUR+XHR
      DO 2800 I=1,NR
      DO 2600 J=1,NLEV
      IF(VAL(I).LE.LEV(J)) GOTO 2700
 2600 CONTINUE
      J = NLEV + 1
 2700 FCAT(J,I)=FCAT(J,I)+1.
      FCAT(MLEV,I)=FCAT(MLEV,I)+VAL(I)
 2800 CONTINUE
      GO TO 1500
C
C     END OF DATA READ LOOP
C
 3000 IF(HOUR.GT.0.0) GO TO 3100
      WRITE(IPUT,10)
   10 FORMAT(/,'   INPUT FILE TOO SHORT.')
      GO TO 9000
 3100 DO 3300 I=1,NR
      DO 3200 J=1,MLEV
      FCAT(J,I)=FCAT(J,I)*XHR/HOUR
 3200 CONTINUE
 3300 CONTINUE
      LEV(NLEV+2) = HOUR
      DO 6000 ISTART=1,NR,16
      IEND=MIN0(ISTART+15,NR)
      DO 5900 LSTART=1,MLEV,5
      LEND=MIN0(LSTART+4,MLEV)
      CALL PAGE
      WRITE(IPUT,11)NHR,HOUR
   11 FORMAT(/,6X,'CUMULATIVE FREQUENCIES OF ',I5,'-HOUR AVERAGES FOR ',
     X  F5.0,' OBSERVATIONS')
      IF(LEND.NE.MLEV) GO TO 5700
      KT=(LEND-LSTART+1)
      GO TO (4100,4200,4300,4400,4500),KT
 4100 WRITE(IPUT,13)
   13 FORMAT('0   ','RECEPTOR   IAVG:# OBS= I')
      GO TO 4600
 4200 WRITE (IPUT,14)
   14 FORMAT('0   ','RECEPTOR   I',1('   LEVEL   I'),'AVG:# OBS= I')
      GO TO 4600
 4300 WRITE(IPUT,15)
   15 FORMAT('0   ','RECEPTOR   I',2('   LEVEL   I'),'AVG:# OBS= I')
      GO TO 4600
 4400 WRITE(IPUT,16)
   16 FORMAT('0   ','RECEPTOR   I',3('   LEVEL   I'),'AVG:# OBS= I')
      GO TO 4600
 4500 WRITE(IPUT,17)
   17 FORMAT('0   ','RECEPTOR   I',4('   LEVEL   I'),'AVG:# OBS= I')
 4600 WRITE(IPUT,18)(LEV(IL),IL=LSTART,LEND)
   18  FORMAT(15X,'I',5(1X,F10.1,'I'))
      WRITE(IPUT,20) (X1,X1,X2,K=1,KT)
   20 FORMAT(15X,'+',5(3A4))
      GO TO 5750
 5700 WRITE(IPUT,25)
   25 FORMAT(/,4X,'RECEPTOR   I',5('   LEVEL   I'))
      WRITE(IPUT,26)(LEV(IL),IL=LSTART,LEND)
   26 FORMAT(15X,'I',5(1X,F10.1,'I'))
      WRITE(IPUT,24) (X1,X1,X2,K=LSTART,LEND)
   24 FORMAT(15X,'+',5(3A4))
 5750 CONTINUE
      DO 5850 IR=ISTART,IEND
      DO 5800 J=LSTART,LEND
      VIOL(IR)=VIOL(IR)+FCAT(J,IR)
      FREQ(J)=VIOL(IR)
 5800 CONTINUE
      IF(LEND.NE.MLEV) GO TO 5820
      FREQ(MLEV)=FCAT(MLEV,IR)
      FCAT(MLEV,IR) = 0.0
 5820 WRITE(IPUT,30)IR, (FCAT(IL,IR),IL=LSTART,LEND)
   30 FORMAT(6X,I4,5X,'I',5(F10.4,' I'))
      WRITE(IPUT,31) (FREQ(IL),IL=LSTART,LEND)
   31 FORMAT(4X,'CUM FREQ',3X,'I',5(F10.4,' I'))
      WRITE(IPUT,24) (X1,X1,X2,K=LSTART,LEND)
 5850 CONTINUE
 5900 CONTINUE
 6000 CONTINUE
      CALL PAGE
      RETURN
C
 8000 WRITE(IPUT,40)
   40 FORMAT(/,'   FIRST DATA LINE FORMAT ERROR.')
 9000 WRITE(IPUT,41)
   41 FORMAT(/,'   EXECUTION TERMINATED DUE TO FATAL ERROR IN CUMFREQ.')
      STOP
      END
      SUBROUTINE AVERGE
C
C***********************************************************************
C
C       THIS ROUTINE CREATES A NEW FILE OF RUNNING (OVERLAPPING)
C       AVERAGES FOR A USER-SPECIFIED LENGTH OF PERIOD
C
C       ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       ANALYSIS  VERSION 2.30    LEVEL 851125
C
C***********************************************************************
C
      DIMENSION SIGMA(400),CONC(400),MET(4),TEMP(24,400),
     *AVG(400)
      LOGICAL EOF1
      INTEGER MET
      IC = 5
      IPR = 6
      ISPT=1
      ICH = 8
      IOUT = 9
C
      WRITE(IPR,45)
   45 FORMAT(//,'   AVERAGE',///)
C
      DO 500 I = 1,400
  500 SIGMA(I) = 0.0
      READ(IC,1,ERR=8100) N,NRECP
    1 FORMAT(2I5)
      WRITE (IPR,2) N,NRECP
    2 FORMAT(10X,'# OF HOURS = ',I5,', # OF RECEPTORS = ',I5)
      IF(N.GT.1) GO TO 1000
      WRITE(IPR,3)
    3 FORMAT(/,'   NUMBER OF HOURS TOO SMALL.')
 1000 NR=N-1
      DO 1500 IREC=1,NR
      CALL READIT(MET,CONC,NRECP,ICH,EOF1)
      IF(EOF1) GO TO 8500
      ISPT=ISPT+1
      DO 1200 J=1,NRECP
      SIGMA(J)=SIGMA(J)+CONC(J)
      TEMP(ISPT,J)=CONC(J)
      IF (NR.EQ.1)  TEMP(N,J)=0
 1200 CONTINUE
 1500 CONTINUE
      IREC=0
 1700 CALL READIT(MET,CONC,NRECP,ICH,EOF1)
      IF (EOF1) GO TO 5000
      ISPT=ISPT+1
      IF (ISPT.GT.N) ISPT=1
      DO 2000 J=1,NRECP
      SIGMA(J)=SIGMA(J)+CONC(J)-TEMP(ISPT,J)
      AVG(J)=SIGMA(J)/FLOAT(N)
      TEMP(ISPT,J)=CONC(J)
 2000 CONTINUE
```

```
      CALL WRITIT(MET,AVG,NRECP,IOUT)                                   AVG00058
      IREC=IREC+1                                                       AVG00059
      GO TO 1700                                                        AVG00060
 5000 WRITE(IPR,10)IREC                                                 AVG00061
   10 FORMAT(/,10X,I5,' RECORDS UPDATED')                               AVG00062
      CALL PAGE                                                         AVG00063
      RETURN                                                            AVG00064
C                                                                       AVG00065
 8100 WRITE(IPR,11)                                                     AVG00066
   11 FORMAT(/,'   ILLEGAL CARD FORMAT FOR DATA.')                      AVG00067
      GO TO 9000                                                        AVG00068
 8500 WRITE(IPR,12)                                                     AVG00069
   12 FORMAT(/,'   UNEXPECTED END OF FILE.')                            AVG00070
 9000 STOP                                                              AVG00071
      END                                                               AVG00072
      SUBROUTINE SEQADD
C
C*******************************************************************
C
C      THIS ROUTINE CREATES A NEW FILE OF CONCENTRATIONS ADDED (AND
C      POSSIBLY SCALED) FROM A TOTAL OF 1 TO 5 INPUT CONCENTRATION FILES
C
C       ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C       ANALYSIS  VERSION 2.30    LEVEL 851125
C
C*******************************************************************
C
      DIMENSION CONC(400),MET(4),TEMP(400),SCALE(5)
      LOGICAL EOF1
      INTEGER MET
      IC = 5
      IPR = 6
      IOUT = 10
C
      READ(IC,*,ERR=8100) N,NRECP
      IF(N.LT.1.OR.N.GT.5) GO TO 8300
      IF(NRECP.LT.1.OR.NRECP.GT.400) GO TO 8400
      READ(IC,*,ERR=8200) (SCALE(I),I=1,N)
      WRITE(IPR,25)
   25 FORMAT(//,'   SEQADD',///)
      WRITE(IPR,30) (I,SCALE(I),I=1,N)
   30 FORMAT(//,(5X,'FILE # ',I1,':  SCALE FACTOR = ',F12.6))
C
      IREC = 0
  300 DO 500 I = 1,400
  500 CONC(I) = 0.0
      DO 1000 IFILE=1,N
      ICH = 10 + IFILE
      CALL READIT(MET,TEMP,NRECP,ICH,EOF1)
      IF(EOF1) GO TO 5000
      DO 800 J=1,NRECP
  800 CONC(J) = CONC(J) + TEMP(J)*SCALE(IFILE)
 1000 CONTINUE
      CALL WRITIT(MET,CONC,NRECP,IOUT)
      IREC = IREC + 1
      GO TO 300
 5000 WRITE(IPR,10)IREC
   10 FORMAT(//,10X,I5,' HOURS SUMMED')
      CALL PAGE
      RETURN
C
 8100 WRITE(IPR,11)
   11 FORMAT(/,'   FORMAT ERROR IN READING NUMBER OF FILES, RECEPTORS.')
      GO TO 9000
 8200 WRITE(IPR,12)
   12 FORMAT(/,'   FORMAT ERROR IN READING SCALE FACTORS.')
      GO TO 9000
 8300 WRITE(IPR,13)
   13 FORMAT(/,'   # OF INPUT FILES NOT BETWEEN 1 AND 5.')
      GO TO 9000
```

```
8400 WRITE(IPR,14)                                                       SEQ00058
  14 FORMAT(/,'    # OF RECEPTORS NOT BETWEEN 1 AND 400.')              SEQ00059
9000 WRITE(IPR,20)                                                       SEQ00060
  20 FORMAT(1X,'    *** FATAL ERROR ***')                                SEQ00061
     STOP                                                                SEQ00062
     END                                                                 SEQ00063
```

```
      SUBROUTINE WRITIT(MET,CONC,NREC,ICH)
C
C********************************************************************
C
C     THIS ROUTINE WRITES ONE CONCENTRATION FILE RECORD, WHICH HAS UP
C     TO 400 RECEPTOR CONCENTRATIONS.
C
C     MET     ARRAY CONTAINING METEOROLOGY: WD,WS,MIX,IST
C     CONC    ARRAY OF SIZE NREC TO RECEIVE CONCENTRATION VALUES
C     NREC    # OF CONCENTRATIONS TO BE WRIT FOR EACH RECORD
C     ICH     INPUT CHANNEL FOR WRITING DATA
C
C
C     ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C     696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C
C     ANALYSIS  VERSION 2.30    LEVEL 851125
C
C********************************************************************
C
      DIMENSION CONC(NREC),MET(4)
      INTEGER MET
C
      WRITE(ICH) MET,CONC
      RETURN
      END
```

```
        SUBROUTINE READIT(MET,CONC,NREC,ICH,EOF1)
C
C********************************************************************
C
C       THIS ROUTINE READS ONE CONCENTRATION FILE RECORD, WHICH HAS UP
C       TO 400 RECEPTOR CONCENTRATIONS.
C
C       MET     ARRAY CONTAINING METEOROLOGY: MIX,WD,IST,WS
C       CONC    ARRAY OF SIZE NREC TO RECEIVE CONCENTRATION VALUES
C       NREC    # OF CONCENTRATIONS TO BE READ FOR EACH RECORD
C       ICH     INPUT CHANNEL FOR READING DATA
C       EOF1    END OF FILE LOGICAL VARIABLE
C
C       ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C       696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C
C       ANALYSIS  VERSION 2.30    LEVEL 851125
C
C********************************************************************
C
        LOGICAL EOF1
        DIMENSION CONC(NREC),MET(4)
        INTEGER MET
C
        EOF1 = .FALSE.
        READ(ICH,END=1000) MET,CONC
        RETURN
 1000   EOF1 = .TRUE.
        RETURN
        END
```

```
      SUBROUTINE LINES(N)
C
C**********************************************************   **********
C
C       N       NUMBER OF NEW LINES
C
C      ENVIRONMENTAL RESEARCH AND TECHNOLOGY, INC.
C      696 VIRGINIA ROAD, CONCORD, MASS. 01742
C
C      ANALYSIS  VERSION 2.30     LEVEL 851125
C
C***********************************************************************
C
      COMMON /HEAD/ NPAGE,NLINE
      NLINE = NLINE + N
      IF(NLINE.LE.63) RETURN
      CALL PAGE
      NLINE = NLINE + N
      RETURN
      END
      SUBROUTINE PAGE
C********************************************************************
C
C      THIS ROUTINE SKIPS TO A NEW PAGE AND WRITES A PAGE HEADER
C
C      ENVIRONMENTAL  RESEARCH AND TECHNOLOGY
C      696 VIRGINIA ROAD, CONCORD, MASS 01742
C
C      ANALYSIS  VERSION 2.30    LEVEL 851125
C
C********************************************************************
C
      COMMON /HEAD/ NPAGE,NLINE
      NPAGE=NPAGE+1
      NLINE=3
      WRITE(6,1000) NPAGE
 1000 FORMAT('1','      POST-PROCESSING ANALYSIS PROGRAM     VERSION ',
     X '2.30      LEVEL 851125',22X,'PAGE',1X,I3,/)
      RETURN
      END
```

APPENDIX D

MODEL COMPARISONS WITH MONITORING DATA

APPENDIX D

MODEL COMPARISONS WITH MONITORING DATA

The reference listed below can be consulted for examples of evaluations of RTDM with other air quality models.

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Moore, G.E., M. Liu, 1983 and R.J. Londergan. Diagnostic Validation of Gaussian and First-Order Closure Plume Models at a Moderately Complex Terrain Site. Prepared for Electric Power Research Institute, 3412 Hillman Ave., Palo Alto, CA 94303. Draft Final Report, SAI 621/5.4/20.

Wackter, D.J. and R.J. Londergan 1984. Operational Evaluation of Eight Complex Terrain Models for Potential Use in Regulating Applications presented at Fourth Joint Conference on Applications of Air Pollution Meteorology, October 1984, Portland, Oregon. pp:J17-J20.

Wackter, D.J. and R.J. Londergan 1984. Evaluation of Complex Terrain Air Quality Simulation Models. EPA-450/4-84-017, Office of Air Quality Planning and Standards, EPA, Research Triangle Park, NC 27711. 243 pp.

White, F., J. Ching, R. Dennis, and W. Synder 1985. Summary of Complex Terrain Model Evaluation. Atmospheric Sciences Research Laboratory, U.S. EPA, Research Triangle Park, NC 27711. 124 pp.